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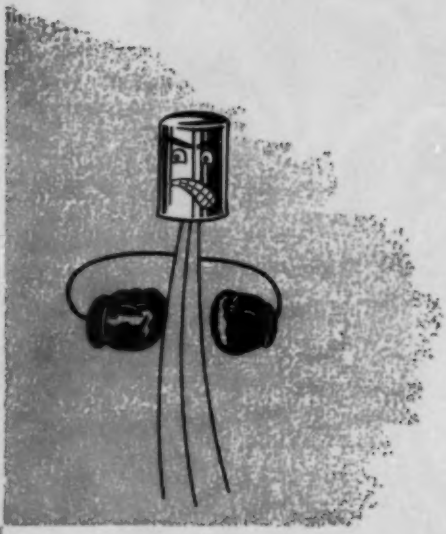

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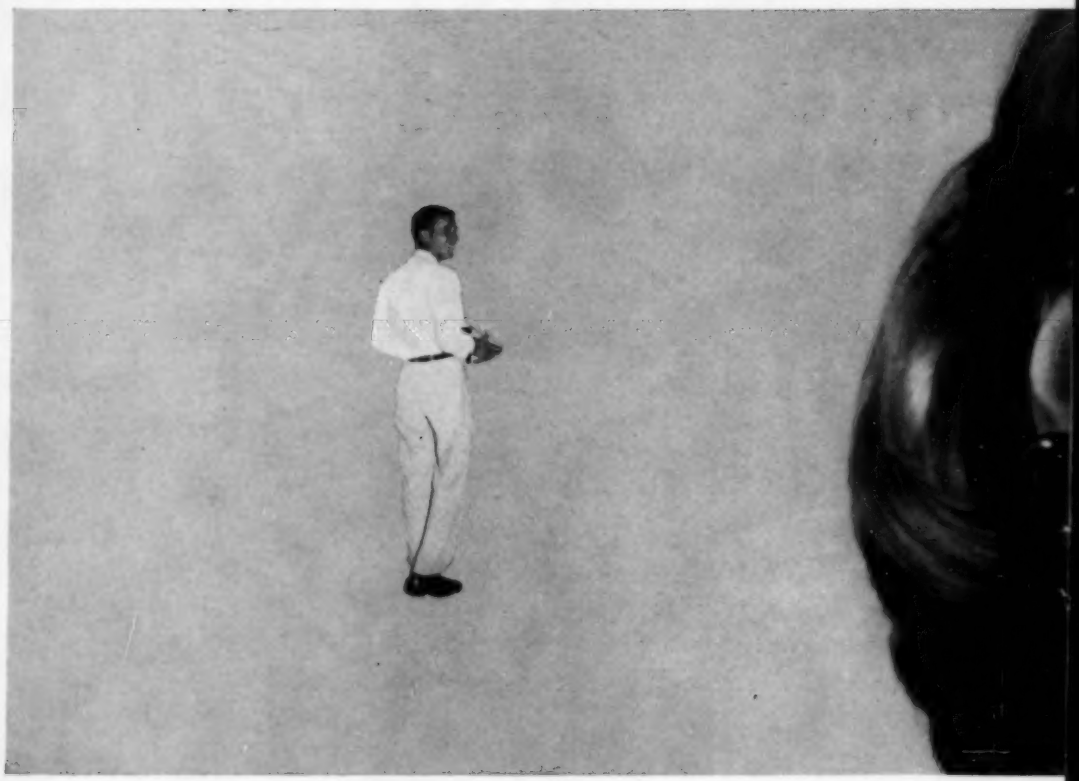

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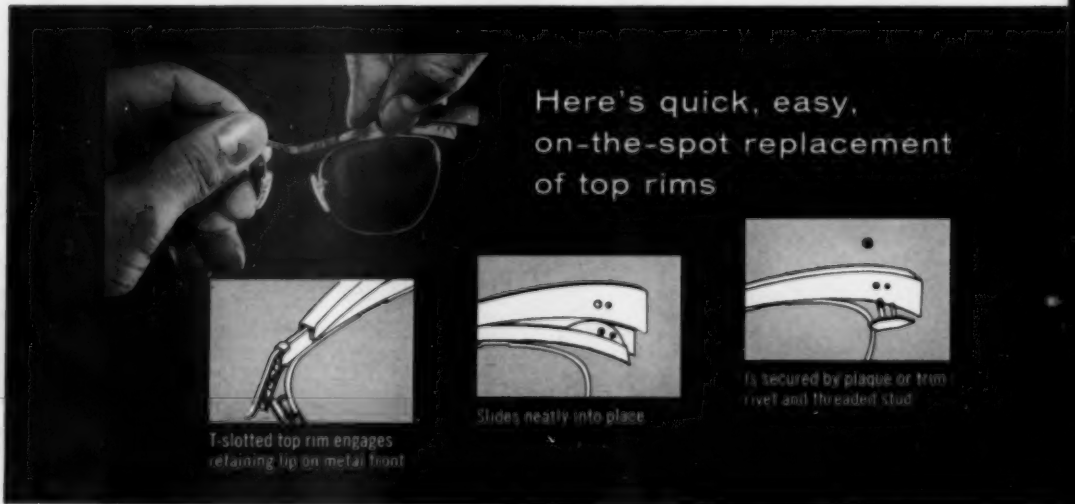
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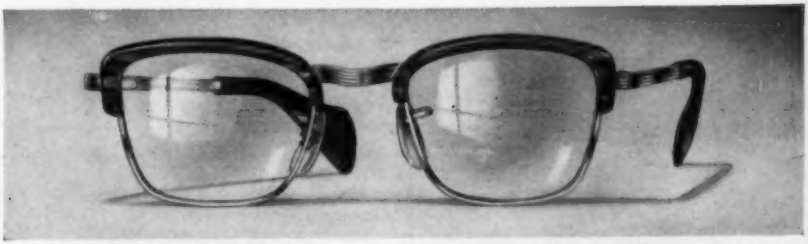

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AMERICAN JOURNAL OF OPTOMETRY
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EFFECTS OF AGE ON VISIBILITY*

Sylvester K. Guth†
Lamp Division, General Electric Company
Cleveland, Ohio

Many criteria have been used for evaluating the effects of age upon visual processes and other functions of the human organism. Although most of the results of such studies have shown a decline in various biological functions with increasing age, only a few of the criteria have been helpful in the development of a sound basis for lighting practice. Statistics show that the average age of our working population is slowly but steadily increasing. It seems entirely logical that these older workers should be provided with all possible aids so that full and continued use can be made of their acquired skills and abilities. How well they perform is among other factors a function of how well they see. Since vision plays such an important role in their work, it follows that adequate light and lighting must be provided.

In a previous paper[1] data were presented to illustrate the differences in visibility obtained by each of a group of 40 observers for constant viewing conditions. One analysis of the experimental data in terms of age groups indicated a trend toward higher levels of illumination by older workers. However, an insufficient number of observers in most of the groups did not permit definite conclusions. Furthermore, in this earlier investigation, no specific attention was paid to the refractive condition of the eyes of the observers. Therefore, it was decided to make an additional study in which these factors could be taken into consideration. In other words, if an equal refractive status could be created for all observers, it could be assumed that differences of visibility levels obtained by those in various age groups must be attributed to factors other than refractive differences. Such factors include a decrease in retinal sensitivity with age, an increase of optical opacities in the ocular media of the aging individual, a decrease of response threshold and of the integration of excitation patterns in the visual centers with advancing age, or a combination of these or other factors. It is emphasized that the present

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†D.O.S., Fellow, American Academy of Optometry. Manager, Radiant Energy Effects Laboratory.

investigation and the detailed analysis of the findings are only concerned with the effect of age on visibility and not with the physiological or optical causes that may bring this about.

EXPERIMENTAL PROCEDURE

Refractive Status.—In order to place all observers on an equal refractive basis, each individual was checked by the sensitometric method of refraction.[2] This involves an application of the Luckiesh-Moss visibility meter which is used in conjunction with a specially designed test object and convergence target. The technique involves the determination of the lens power required by the observers to achieve maximal visibility with standardized viewing conditions. This has been found a useful and accurate method for determining refractive errors.

The viewing distance of 16 inches used in the sensitometric check was the same as that used for visibility measurements in this investigation. Those observers normally wearing glasses for near work wore them during the sensitometric examination and during all subsequent test periods. Each observer was provided with additional correction, if needed, as determined by sensitometry. That is, the vision of each observer was properly corrected for the viewing distance used in this investigation. This is, of course, particularly important for presbyopic observers whose normal near correction may be for distances other than 16 inches. Younger observers generally would experience no difficulty because of their wider amplitude of accommodation. Thus, in so far as was possible, all observers were placed on an equal refractive basis.

Observers.—One hundred typical office and laboratory workers participated as observers. Their ages ranged from 17 to 65 years; thirty-eight of the observers were presbyopic. No special selection was made except to exclude those who had pathological or uncorrectable eye defects. Most members of the group had never been observers in investigations of this type. The distribution of ages permitted a convenient grouping for an analysis of the experimental results. (See Table III for pertinent information regarding the groups and Table VIII regarding individual ages.)

Procedure.—Visibility data were obtained with the Luckiesh-Moss visibility meter.[3, 4] Each observer made a series of ten measurements of the visibility of 7-letter words which contained no letters with ascenders or descenders. The following words, which were similar near the threshold, were selected:

amorous	measure
awesome	nervous
coarsen	remorse
concave	surname
ensnare	uncover

They were well printed in 6-point type on white paper. A style of type was especially selected for its simplicity and uniformity of width of stroke. The size was chosen so that visibility measurements would be within the limits of the L-M visbility meter for the footcandle levels used in the investigation.

The observers were permitted to familiarize themselves with all the words prior to the test in order to minimize any effects of learning upon the results. In the investigation the words were presented one at a time in random order and the threshold of visibility was determined. The observer was required to name the word upon recognition.

Measurements were made with levels of illumination ranging from 10 to 100 footcandles. Care was taken to insure that the surroundings had minimal effect upon the observations. The visibility data for each observer were plotted and from the resulting curves the footcandle levels necessary to obtain visibility levels of 3, 4, 5, 7 and 10 were determined. These footcandle levels have been used for the analyses in this paper.

EXPERIMENTAL RESULTS

Space does not permit presenting all experimental data of each individual. Therefore the individual averages of the visibility levels obtained by a small number of representative observers with several footcandle levels are shown as a sample in Table I. The 12 observers listed include two from each of the six age groups. Also included are the averages of the total group of 100 observers. These data are typical of those obtained with the L-M visibility meter over a period of many years. From such data it is possible to determine the footcandles necessary to obtain any desired visibility level.[5]

TABLE I.

Visibility levels obtained by representative observers with several footcandle levels when viewing 6-point type at a distance of 16 inches.

Observer No.	Age	Footcandles 10	20	40	80	100
16	17	2.8	3.8	5.5	8.6	10.2
5	20	3.3	4.6	6.7	10.2	12.5
51	21	2.6	3.4	4.8	7.6	10.0
72	27	2.9	4.3	6.6	10.7	12.5
70	31	2.6	3.5	5.0	8.2	10.0
55	40	3.2	4.2	6.0	8.7	12.0
77	44	2.2	3.3	5.0	8.0	10.0
7	49	3.0	4.0	5.6	8.2	9.4
21	53	2.4	3.2	4.4	6.6	7.9
27	60	2.6	3.4	4.7	7.3	8.9
92	62	2.0	2.7	3.8	6.0	7.3
12	65	2.0	2.4	3.3	5.5	6.7
Average of 100 observers		2.61	3.63	5.22	8.76	10.90

TABLE II.
Footcandles required by representative observers to obtain specific visibility levels.

Observer No.	Age	3	4	5	7	10
16	17	12	22	34	60	97
5	20	8	15	24	44	78
51	21	14	28	44	73	100
72	27	11	18	36	44	73
70	31	14	21	40	66	100
55	40	9	18	28	52	83
77	44	17	28	40	66	100
7	49	10	20	32	61	110
21	53	18	33	50	86	130
27	60	15	29	45	76	110
92	62	25	43	62	95	125
12	65	34	53	71	105	145
Average of 100 observers		14	25	37	61	93

Another, and perhaps more practical presentation of the data is in terms of the footcandles required for specific visibility levels. These are shown in Table II for the same observers listed in Table I. The footcandle values of Table II were obtained from plots of the individual observed data of Table I.

As was demonstrated in a previous paper,[1] variations among observers are considerable. Similar individual differences, as representatively shown in Tables I and II, were found among all the observers in this study. This will be discussed in detail later.

EFFECT OF AGE

Visibility.—In order to evaluate the effect of age upon visibility, the observers were combined into six age groups as shown in Table III. Included in this table are the average visibility levels obtained by each group for several footcandle levels. These data are illustrated graphically in Figure 1. The decrease in visibility is gradual up to an age of about 45, after which the change becomes more pronounced. For example, the change in visibility between Groups 4 and 5 is about the same as the

TABLE III.
Average visibility levels obtained by observers in various age groups for several footcandle levels when viewing 6-point type at a distance of 16 inches.

Group No.	1	2	3	4	5	6	
Age Range	17-20	21-30	31-40	41-50	51-60	61-65	
Average age	19	26	36	46	56	63	
No. of observer	12	17	22	21	21	7	
Footcandles	Visibility Level						Average All Groups
20	3.95	3.86	3.80	3.63	3.38	2.79	3.63
30	4.90	4.80	4.70	4.50	4.12	3.38	4.48
50	6.83	6.67	6.42	6.08	5.48	4.60	6.12
80	9.79	9.68	9.30	8.62	7.70	6.60	8.76

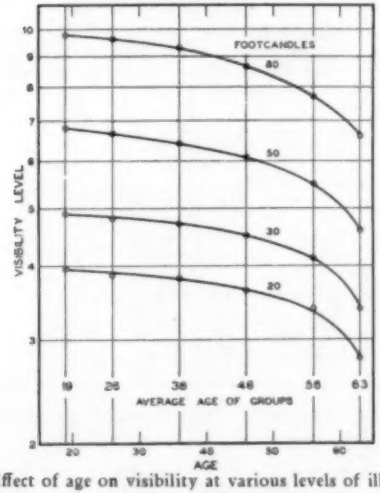

Fig. 1. Effect of age on visibility at various levels of illumination.

change between Groups 1 and 4. The decrease between the last two groups is greater than that between Groups 1 and 5. The oldest and youngest groups attain a visibility level of slightly less than 5 with 50 and 30 footcandles, respectively. It is noted that the curves of Figure 1 are essentially parallel, indicating that all groups respond equally to changes in brightness as the level of illumination is increased.

An analysis of the relative visibilities obtained by the various age groups, as shown in Table IV, is particularly revealing. When the data are considered in relation to the visibility level obtained by the youngest group (Table IV-A), it is seen that each group has a fairly constant and equal decrease in visibility for all footcandle levels. The oldest group has the greatest reduction in visibility, the average being about two-thirds that of the youngest group.

The relative visibilities in terms of the visibility level obtained by each group with 20 footcandles (Table IV-B) show that all age groups receive the same relative benefits as the illumination is increased. When the illumination is increased progressively from 20 to 30, 50 and 80 footcandles, the average improvements in visibility are 23, 68 and 142 percent respectively. It is interesting to note that the improvement obtained is about equal when increasing the illumination from 30 to 50 and from 50 to 80 footcandles, being 37 and 44 percent, respectively. The percentage increase in illumination in these two cases is approximately 60 percent. In other words, within this particular range of

TABLE IV.

Relative visibility levels in terms of (A) the visibility obtained by the youngest group and (B) the visibility obtained by each group with 20 footcandles

Footcandles	Age Groups 1 17-20	2 21-30	3 31-40	4 41-50	5 51-60	6 61-65	Average All Groups
A. In terms of youngest group							
20	100	98	96	92	86	71	----
30	100	98	96	92	84	69	----
50	100	98	94	89	80	67	----
80	100	99	95	88	79	67	----
Averages	100	98	95	90	82	68	----
B. In terms of visibility with 20 footcandles							
20	100	100	100	100	100	100	100
30	124	124	124	124	122	121	123
50	173	172	169	167	162	165	168
80	248	256	245	237	228	236	242

illumination and visibility, a 60 percent increase in the former provides a 40 percent increase in the latter.

Illumination—In Table V-A are shown the average footcandles required by each group of observers to obtain specific visibility levels. The data are plotted in Figure 2. As in the preceding analysis, for a specific visibility level the illumination increases but slowly until an age of about 45 or 50 when the lighting requirements increase more markedly. Since the older observers, all of whom were presbyopic, were provided with the proper correction for the 16-inch viewing distance, the need for higher footcandles is not considered a function of uncorrected refractive errors.

Approximately 30 footcandles will provide the youngest group

TABLE V.

Average footcandles and relative footcandles required by observers in various age groups to obtain several visibility levels.

Visibility Level	Age Group 1 17-20	2 21-30	3 31-40	4 41-50	5 51-60	6 61-65	Average of all groups
A. Footcandles							
3	11	12	12	13	16	23	14
4	20	21	22	24	28	40	25
5	31	33	33	36	43	56	37
7	52	53	56	61	71	85	61
10	82	83	87	94	105	117	93
B. Relative Footcandles							
3	100	100	100	100	100	100	----
4	182	175	183	185	175	174	----
5	282	275	275	277	269	243	----
7	473	442	467	469	444	369	----
10	746	692	725	723	656	509	----

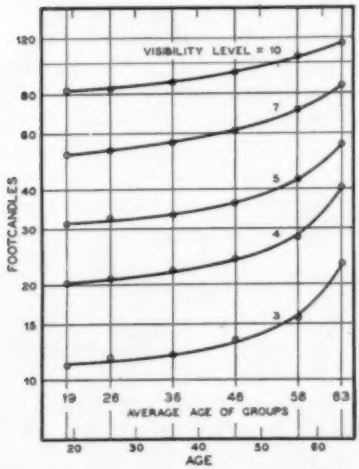

Fig. 2. Effect of age on illumination requirements for obtaining specific visibility levels.

with a visibility level of 5. However, the oldest group will achieve a visibility of only about 3.5 with this illumination and requires almost 60 footcandles for attaining a visibility level of 5.

Using the youngest group as a basis of comparison, the next three older groups require 5, 8 and 17 percent more illumination. It should be noted that these values are fairly constant for all visibility levels. However, the percentage increases in illumination for the two older groups are not so constant for all visibility levels, becoming smaller with the higher visibility levels. The values for the 51-60 age group range from 45 down to 28 percent for visibility levels of 3 and 10, respectively. The differences are even more marked for the oldest group as shown in the following tabulation:

Visibility Level	3	4	5	7	10
Increase in illumination, percent	109	100	81	63	43

These values indicate, for example, in terms of the youngest group that about twice as much illumination is required by the older workers for a visibility level of 3, and only half again as much for a visibility level of 10.

The relative footcandle values of Table V-B indicate that all except the oldest group require about the same percentage change in illumination for a given improvement in visibility. These findings are in agreement with the relative visibility data of Table IV. However, for the oldest group, a progressively smaller percentage increase in foot-

candles is required as the visibility level is increased. That is, a doubling of the illumination is more effective for the oldest observers and will provide them with a greater improvement in visibility than the younger workers. This is in agreement with Weston.[6] However, it must be remembered that for a given visibility level, footcandle requirements increase with age (Table V-A) and that the reference level for the relative footcandles is different for each group. Furthermore, in every instance the older groups require more illumination.

The higher footcandle requirements indicate that the older workers need a greater brightness difference[7] for a given visibility level. Similarly, the increase in absolute differences in illumination for visibility levels of 3 and 10 with the increase in age of the groups show the need for larger brightness differences for a given improvement in visibility. These differences for the oldest and youngest groups are 94 and 71, respectively. These indicate that, for the specific task used in this investigation, the former require a 30 percent greater brightness difference for the same improvement in visibility.

PERCENT MAXIMAL VISIBILITY

The scale of visibility has been found to be extremely useful for most applications of the L-M visibility meter. However, it does have the disadvantage that scale values approach infinity rather than a definite maximal value with, for example, higher levels of illumination. This disadvantage is minimized by using a scale of *percent maximal visibility* (PMV) which is based upon rational limits of both maximal and minimal visibility.[8] Maximal visibility represents a degree of visibility exceeding that obtainable with objects indefinitely large in size of maximal contrast with a brightness level of 10 footlamberts. Zero PMV corresponds to the visibility of an object having a contrast of 13 percent and a size of 1.9 minutes. This results in a scale that is convenient for visualizing the percentages gained by improvements in seeing conditions. It has the advantage of agreeing with the usual concept of "diminishing returns" received from most visual stimuli.

The relationship between visibility level and PMV is illustrated in Table VI. These illustrate that about the same percentage point gain is received by improving visibility from 7 to 10 as by 4 to 5. It should be obvious that the PMV scale provides a more rational increasing effectiveness in terms of stimulus-response relationships. A doubling of visibility level has never been indicated as representing a corresponding improvement in ability to see. An improvement in PMV from 58 to 80 percent (for visibility levels of 5 and 10, respectively) seems considerably more logical in terms of sensory processes.

TABLE VI.
The relationship between visibility level (VL) and percent maximal visibility (PMV)

VL	PMV	VL	PMV
2	4.6	9	76.8
3	33.2	10	79.6
4	48.6	12	83.8
5	58.5	14	86.8
6	64.9	16	89.4
7	69.7	18	91.5
8	73.6	20	93.2

These PMV values may be used in place of the corresponding visibility levels of Table V. Thus, the youngest group obtains 70 percent of maximal visibility when this specific task is illuminated by 52 footcandles. On the other hand, the oldest group will obtain a PMV of about 56 with this level of illumination and require 85 footcandles to obtain a PMV of 70.

The data in Table VII show the relationships between footcandles and PMV for the various age groups. The PMV values correspond to the visibility levels of Table III. They illustrate again the small change in visibility for a given footcandle level for observers less than 45 or 50 years of age. However, the decrease in PMV becomes progressively more pronounced for the older observers. For example, a PMV of 58 was obtaind by the youngest group with 30 footcandles; this compares with a PMV of 40 obtained by the oldest group. These correspond to visibility levels of 4.90 and 3.38, respectively, as shown in Table III. In other words, with 30 footcandles the youngest observers achieve about 45 percent better visibility in terms of the PMV scale. The oldest group will require about 60 footcandles to obtain a PMV of 58.

Increasing the illumination four times, from 20 to 80 footcandles, improves the PMV of the youngest group from 48 to 79 or about 65 percent. The improvement obtained by the oldest group for the same increase in illumination is from 29 to 68, which amounts to 135 percent. This illustrates that the latter group gains more than any of the younger groups.

TABLE VII.
Percent Maximal Visibility corresponding to the values of Visibility Levels of Table III.

	Age Group					
	1	2	3	4	5	6
	17-20	21-30	31-40	41-50	51-60	61-65
Footcandles			PMV			
20	48	47	46	44	40	29
30	58	57	56	54	50	40
50	69	68	67	65	62	55
80	79	79	78	76	71	68

On another basis, when the illumination is increased from 20 to 80 footcandles, the oldest group improves from 60 percent to 85 percent of the PMV obtained by the youngest group. In other words, higher levels of illumination tend to close the gap in visibility levels obtained by various age groups and by individual observers. This is shown graphically in Figure 3 in which have been plotted the relationships between

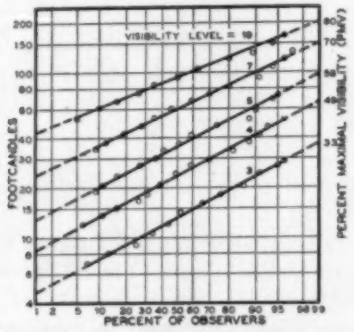

Fig. 3. Relationships between footcandle level and percent maximal visibility for the average of all data, the youngest and oldest age groups, and two observers who represent the extremes. The dashed lines indicate probable extrapolations of the curves.

footcandle level and percent maximal visibility for the average of all observers for the youngest and oldest age groups, and for two observers who represent the extremes. What seem to be logical extrapolations are indicated by the dashed lines. If the illumination were several hundred footcandles, the differences in PMV would be relatively small. For example, with 400 footcandles the indicated range would be from 93 to 98.

INDIVIDUAL DIFFERENCES

As was noted in Table I, there are considerable differences among the visibility levels obtained by various observers for a specific footcandle level. Similarly, the illumination required for a given visibility level varies considerably as shown in Table II. This is further illustrated by the data in Table VIII in which are presented footcandles for a visibility level of 5 related to the age of each observer. They are arranged in order of decreasing footcandles within each age group. The range in illumination for *all* observers is large, being from 15 to 105, with an average value of 37 footcandles. Furthermore, large differences exist among observers within the same age group and even among those of the same age. The average deviations within the age groups vary from 27 to 35 percent. It is interesting to note that a 33-year-old ob-

TABLE VIII.

Footcandles required to obtain a Visibility Level of 5 for each of 100 observers, arranged according to decreasing footcandles within each age group.

Age Group												
17 - 20		21 - 30		31 - 40		41 - 50		51 - 60		61 - 65	
FC	Age	FC	Age	FC	Age	FC	Age	FC	Age	FC	Age
46	19	74	26	57	36	69	41	105	55	96	63
42	19	45	28	51	31	62	42	74	57	71	65
41	20	44	21	50	39	57	50	50	53	62	62
38	20	43	26	50	34	50	42	50	59	53	61
34	17	36	21	47	37	46	48	48	56	38	65
34	19	36	25	45	35	43	46	48	56	35	63
33	19	36	27	42	40	43	46	48	58	34	63
24	20	34	21	40	31	43	49	45	60		
23	20	30	25	36	36	40	44	43	57		
23	20	28	28	32	32	38	48	42	53		
19	20	26	23	31	40	33	44	42	60		
17	20	24	28	29	39	32	49	41	56		
		24	28	28	33	31	47	40	55		
		24	29	28	40	27	50	40	56		
		17	25	27	36	26	49	35	56		
		17	29	24	31	23	49	29	56		
		16	24	23	33	22	45	28	54		
				21	39	20	43	27	52		
				20	34	20	43	24	55		
				17	35	17	41	23	60		
				17	38	15	48	19	55		
				16	33						
Averages	31	19	33	26	33	36	36	46	43	56	56	63
Average Deviation Percent	27	----	31	----	33	----	35	----	28	----	32	----

server required the lowest and a 55-year-old observer required the highest level of illumination. Despite the scatter of the individual data, a definite increase in lighting requirements with age is indicated by the averages.

In Table IX are presented the PMV values for the visibility levels obtained by the representative observers (Table I). These illustrate even more emphatically the effects of age upon visual ability and how higher levels of illumination may help to compensate for such reductions. The data for the two extreme observers (Nos. 5 and 12) are plotted in Figure 3. Thus, with 10 footcandles the oldest observer listed in Table IX (No. 12) obtained a PMV of only 5 as compared with a PMV of 39 obtained by observer No. 5. However, with 100 footcandles the older observer can achieve a PMV of 68, which is beginning to approach that achieved by the younger observer.

The scatter of the data as shown by Tables VIII and IX and by Figure 3 emphasizes how much more revealing the data of individual observers are than gross averages. Individual observers generally are very consistent by themselves, as was demonstrated in a previous paper.[1]

TABLE IX.
Percent maximal visibility (PMV) achieved by representative observers with several footcandle levels

Observer No.	Age	Footcandles 10	20	40	80	100
16	17	29	46	62	76	80
5	20	39	55	68	80	85
51	21	24	40	57	72	80
72	27	31	53	68	81	85
70	31	24	42	59	74	80
55	40	37	51	65	76	84
77	44	12	39	59	74	80
7	49	33	49	62	74	78
21	53	18	37	53	68	73
27	60	24	40	56	71	77
92	62	5	27	46	65	71
12	65	5	18	39	62	68
Average of 100 observers		24	44	60	76	82

A similar consistency was found in this investigation. Plots of individual curves relating visibility and footcandle level were remarkably parallel. This is shown by the individual data of Table I, and by the PMV relationships of Figure 3 for two representative observers. Average deviations of individual data are small and indicate relatively high statistical significance of differences. Similarly, if each observer's data are placed on a relative basis in terms of his footcandle requirements for a visibility level of 3, the average deviations within the age groups are less than 10 percent. The standard error of the mean would be about 2.5 percent. In other words, when subjective differences are eliminated, a high reliability of the data is indicated. Nevertheless, the variations among observers of the same or different ages should not detract from the important fact that generally higher footcandle levels contribute to better seeing.

Another method of illustrating the effectiveness of illumination and of emphasizing subjective differences is in terms of the footcandle levels required for various percentages of observers to obtain several specific visibility levels. This is illustrated in Figure 3. These values were derived from all of the individual data, a representative portion of which is shown in Table II. For calculating purposes, the footcandle levels for each visibility level were arranged into 12 to 14 groups. The percentages have been plotted on a normal probability integral scale. Normal or Gaussian distribution is indicated by the straight lines through the open circles which represent the grouped data. Thus, the group of 100 observers can be considered representative of a much larger group.

These relationships represent the percentage of observers who will obtain at least a given visibility level with various footcandle levels.

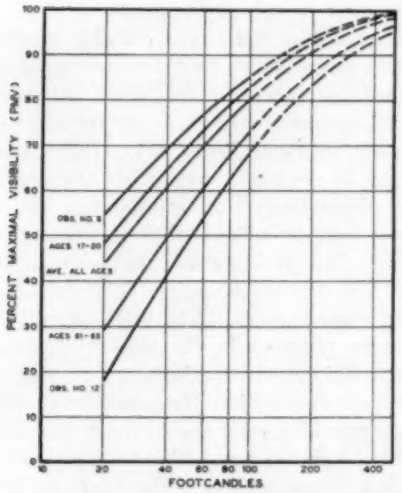

Fig. 4. Relationships between the footcandles necessary for various percentages of observers to obtain given visibility levels.

For example, a visibility level of at least 5 is obtained by 50 percent of the observers with about 35 footcandles. This is the *average* value. However, for 90 percent to achieve this visibility level, they require at least 60 footcandles, and 99 percent need 100 footcandles. In other words, about three times the average footcandle level is required so that practically all of the observers will be able to achieve the visibility level indicated by the average.

Also shown on Figure 4 are the PMV values corresponding to the specific visibility levels. If 100 footcandles are provided for a task such as the one used in this investigation, about 60 percent will obtain at least 80 percent of maximal visibility. Another 30 percent will obtain a PMV of 70, and the last 10 percent will be at the 58 PMV level. In order for the last group to have a PMV of 80, they will require 200 footcandles.

It is interesting to note that the slopes of the relationships of Figure 4 become progressively less as the visibility level increases. That is, when *all* observers are provided with higher footcandle levels, individual differences become less. This was pointed out in connection with Figure 3. In other words, these two entirely different analyses of the experimental data indicate that all observers ultimately would be expected to achieve an approximately equal visibility level with the same high footcandle level.

The data presented in this paper emphasize that, in terms of visibility, older workers require considerably higher levels of illumination in order to achieve a given ability to see. These results agree in general with those obtained by Weston[9] who found that older observers attained a greater improvement in visual performance (combined speed and accuracy) with increased illumination than younger observers. However, according to Weston, even with the highest illumination (500 footcandles) the older group was unable to achieve the same performance as the younger group did with the lowest illumination (0.5 footcandles). Weston's text involved "quickness of perception," eye-hand coordination and manual dexterity. The last two of these factors may limit the performance more than visual perception. On the other hand, the evaluation reported in the present paper are in terms of integrated visual functions and do indicate, on this basis, that older workers can be expected to achieve the same visual abilities as younger workers if they are provided with the necessary footcandle level.

More recently, McFarland and Fisher found that the final level of dark adaptation is a function of age. For example, for every 13 years of age the intensity of illumination must be doubled to make a minimum threshold target visible to the dark adapted eye. While dark adaptation and threshold conditions are not typical of most visual situations, it is logical to conclude that such effects of age probably also are reflected in suprathreshold seeing.

It must be emphasized that the data reported in this paper are for a specific high contrast test object. Therefore the footcandle levels indicated by these experimental visibility measurements must be considered to be on the conservative side. Extensive data are available which relate illumination and brightness to a wide range of sizes and contrasts of tasks.[11] Only if the effects of age and other subjective differences are applied to typical *average* data for determining seeing requirements, can it be said that most everyone will be provided with readily attainable visual ability. Averages are useful for establishing relationships among variables, but are inadequate and can be misleading when used as a basis for establishing lighting requirements. In the latter case, individual differences due to age or other factors cannot and should not be ignored.

The author wishes to gratefully acknowledge the many helpful suggestions of Dr. G. A. Brecher and of A. A. Eastman and J. F. McNelis who conducted the investigation.

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BOOK NOTICE

LENS MATERIALS IN THE PREVENTION OF EYE INJURIES. Arthur H. Keeney, M.D., D.Sc. Published by the Charles Thomas Company, Springfield, Illinois. 73 pages. $3.50.

Optometrists and producers of ophthalmic lenses may find useful data on protective lens materials in this monograph. The purposes of the study include analysis of the technical development of safety lens materials, their experimental characteristics and indications and contra-indications for their use. Laminated glass, thermally toughened glass, plastics, hardness, impact resistance, fracture patterns, thermostability, resistance to chemicals, density to X-rays and flammability receive particular consideration. The book contains 45 references and an index. The author is a member of the Industrial Research Institute of the University of Louisville, School of Medicine.

THOMAS H. EAMES, ED.M., M.D.

BOSTON UNIVERSITY
BOSTON 15, MASSACHUSETTS

A HOMOKONIC CROSS CYLINDER FOR REFRACTIVE PROCEDURES*

Phillip R. Haynes†
Newark, Ohio

This is a report of the principles and applications of a modified Jackson Cross Cylinder designed to eliminate the annoying "scissors effect" which is encountered in the clinical use of this device. During the clinical examination** the patient often reports that the target looks taller with the lens in position one, and wider in position two, or he may report that it first slants in one direction and then in a second direction making it difficult to determine in which position it is the clearer. These two optical phenomenon can be eliminated by utilizing an optical system which has uniform magnification in all meridians. Such a system can be termed a homokonic lens system.***

The angular magnification of a given section of a thick lens system is equal to the ratio of the angle μ' subtended by the image $P_1'\overline{P'}$ and the angle μ subtended by the object $P_1\overline{P}$. (See Figure 1.) One can derive the following equation**** relating the object distance, the optical constants of the lens and the distance between the back surface of the lens and the entrance pupil of the eye.[1,2]

$$M = \frac{\mu'}{\mu} = \left[\frac{1}{1 - \frac{t}{n}\left(\frac{1}{u_1} + F_1\right)}\right]\left[\frac{1}{1 - h\frac{1}{u'_2}}\right]$$

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†Optometrist. Fellow, American Academy of Optometry.

**The typical clinical target has a predominance of vertical and horizontal lines. Statistically speaking there is a high probability that the axis of the astigmatism will be near 90° or 180°. In this clinical situation one will have a maximum effect when testing for the axis and little or no scissors effect when testing for power. On the other hand one will have a maximum differential magnification effect when testing for power and little or none when testing for axis.

***The optical term homokonic is defined as an optical system with uniform magnification. One could also use the Greek compound homoformokonic. The equations for the lens are derived in a general nature, but Table III gives the specifications for a homokonic lens with $M = 1$. This specific lens is designated as a henaformokonic or henakonic lens which indicates that the magnification is unity. These optical terms were compounded by the author and Dr. L. R. Dean, Professor of Greek, Denison University.

****The Southalian[3] sign convention is used in the derivation of these equations.

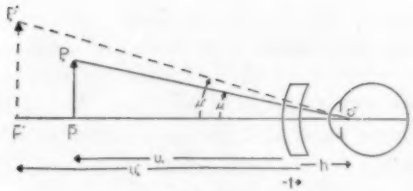

Fig. 1

$$\left[1 - \frac{(t+h)}{u_1}\right] \tag{1}$$

This equation is simplified when one is dealing with large object distances. In this instance

$$\frac{1}{u_1} = O \tag{2}$$

and equation (1) reduces to

$$M = \frac{\mu'}{\mu} = \left[\frac{1}{1 - \frac{t}{n}F_1}\right] \frac{1}{1 - hF_v} \tag{3}$$

where F_v is the vertex power of the lens. This equation can be applied to any given meridian of a sphero-cylinder.

The percentage magnification m is related to the angular magnification by the following equation:

$$m = 100\ (M - 1) \tag{4}$$

Figure 2 shows a compound meridional magnifier mounted before the left eye with the optic axis passing through the center of the entrance pupil and intersecting the target plane perpendicularly at the point $\bar{P}$. The minor axis is positioned at the angle ϕ and coincides with the plane $O\bar{P}P_2$. The major axis is positioned at the angle $(\phi + 90)$. The

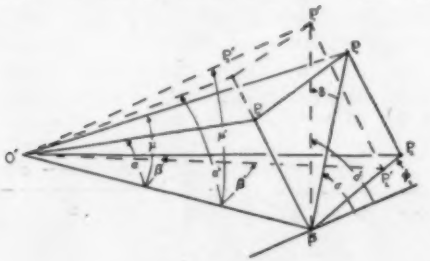

Fig. 2

four object points $\bar{P}$, P_1, P_2, and P_3 form a rectangle in a plane perpendicular to the optic axis. The images of these points formed by the lens are not points since the lens produces astigmatic images. The lines $O'P_1'$, $O'P_2'$, $O'P_3'$ and $O'\bar{P}'$ represent the chief rays converging toward the entrance pupil and projected backward to the plane of the object. The points $\bar{P}'$, P_1', P_2' and P_3' form a rectangle whose sides are parallel and perpendicular to the minor axis meridian.

One can derive the following equations to show how the angular magnification varies as a function of the meridional angle. (See equation 17.)

The ratio $\frac{\beta'}{\beta}$ represents the angular magnification of the minor axis meridian.

$$B = \frac{\beta'}{\beta} \text{ and } b = 100(B\text{-}1) \tag{5}$$

The ratio $\frac{\gamma'}{\gamma}$ represents the angular magnification in the major axis meridian.

$$A = \frac{\gamma'}{\gamma} \text{ and } a = 100(A\text{-}1) \tag{6}$$

The ratio $\frac{\mu'}{\mu}$ represents the angular magnification for a line lying in the meridian at an angle $(\sigma - \phi)$ from the minor axis meridian.

$$M = \frac{\mu'}{\mu} \text{ and } m = 100(M\text{-}1) \tag{7}$$

It follows from Figures 2 and 3 that:

$$M^2 = \frac{\mu'^2}{\mu^2} = \frac{\gamma'^2 + \beta'^2}{\mu^2} = \frac{\gamma'^2}{\mu^2} + \frac{\beta'^2}{\mu^2} \tag{8}$$

$$\text{Since } \cos(\sigma - \phi) = \frac{\beta}{\mu} \tag{9}$$

$$\text{and } \sin(\sigma - \phi) = \frac{\gamma}{\mu} \tag{10}$$

$$\text{and } \mu^2 = \left[\frac{\beta^2}{\cos^2(\sigma - \phi)} \right] = \left[\frac{\sin^2(\sigma - \phi)}{\gamma^2} \right] \tag{11}$$

Therefore:

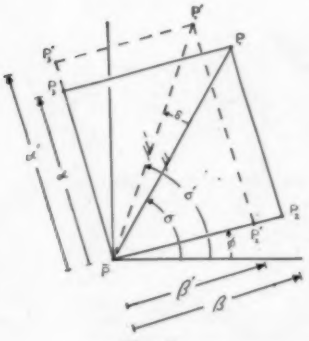

Fig. 3

$$M^2 = \left[\frac{\gamma'}{\gamma}\right]^2 \sin^2(\sigma - \phi) + \left[\frac{\beta'}{\beta}\right]^2 \cos^2(\sigma - \phi) \tag{12}$$

Since, $$A^2 = \left(\frac{\gamma'}{\gamma}\right)^2 = 1 + \frac{2a}{100} \tag{13}$$

and, $$B^2 = \left(\frac{\beta'}{\beta}\right)^2 = 1 + \frac{2b}{100} \tag{14}$$

and, $$M^2 = \left(\frac{\mu'}{\mu}\right)^2 = 1 + \frac{2m}{100} \tag{15}$$

Therefore,

$$1 + \frac{2m}{100} = \left(1 + \frac{2a}{100}\right) \sin^2(\sigma - \phi) + \left(1 + \frac{2b}{100}\right) \cos^2(\sigma - \phi) \tag{16}$$

Solving for m:

$$m = a \sin^2(\sigma - \phi) + b \cos^2(\sigma - \phi) \tag{17}$$

The angular displacement ε of $P_1'\overline{P}'$ from $P_1\overline{P}$ represents the rotary deviation of a line located in the meridian σ produced by the compound meridional magnifier. One can derive the following equations to show how this "scissors effect" or rotary deviation varies as a function of the meridional angle. (See equation 22.)

From Figures 2 and 3 one can derive the following relationships:

$$\text{Tan}\ (\sigma' - \phi) = \frac{\gamma'}{\beta'} \tag{18}$$

and

$$\text{Tan}\ (\sigma - \phi) = \frac{\gamma}{\beta} \tag{19}$$

Dividing we obtain:

$$\text{Tan } (\sigma - \phi) = \text{Tan } (\sigma' - \phi) \frac{\gamma}{\beta} \frac{\beta'}{\gamma'}$$

$$= \frac{B}{A} \text{Tan } \left[\varsigma + (\sigma - \phi) \right] \tag{20}$$

Solving for Tan σ we obtain the relationship:

$$\frac{\text{Tan } \varsigma + \text{Tan } (\sigma - \phi)}{1 - \text{Tan } \varsigma \text{ Tan } (\sigma - \phi)} = \frac{A}{B} \text{Tan } (\sigma - \phi) \tag{21}$$

This reduces to:

$$\text{Tan } \varsigma = \frac{(A - B) \text{ Tan } (\sigma - \phi)}{B + A \text{ Tan}^2 (\sigma - \phi)} \tag{22}$$

In the case of a simple meridional magnifier, B = 1 and ϕ equals the axis meridian. In this specific case equation 22 reduces to:

$$\text{Tan } \varsigma = \frac{(A - 1) \text{ Tan } (\sigma - \phi)}{1 + A \text{ Tan}^2 (\sigma - \phi)} \tag{23}$$

The above analysis shows that there is:

(a) A change in dioptric power as a function of the meridional angle[3].

(b) A change in angular magnification as a function of the meridional angle. (See equation 17.)

(c) A change in rotary deviation or "scissors effect" as a function of the meridional angle. (See equation 22.)

Figure 4 quantitatively shows the rotary deviation effect ς as a

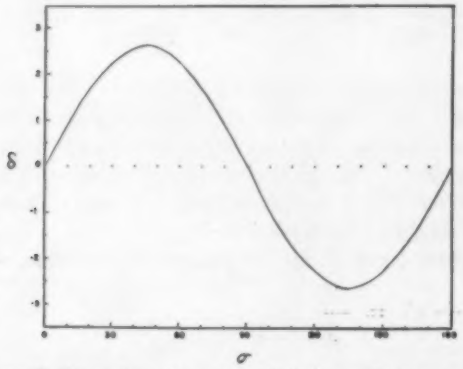

Fig. 4. The graph shows how the rotary deviation ς changes as a function of the meridional angle σ. Plus values of ς indicate clockwise rotation of the scissored line and minus values indicate counter-clockwise rotation.

TABLE I.

Meridian	Deviation
0°	0° 0′
15°	+1° 20′
30°	+2° 15′
45°	+2° 28′
60°	+2° 15′
75°	+1° 20′
90°	0° 0′
105°	—1° 20′
120°	—2° 15′
135°	—2° 28′
150°	—2° 15′
165°	—1° 20′
180°	0° 0′

function of σ when $\phi = O$ and $a = -b = 4.5\%$. Note that the rotary deviation is maximum at 45° and 135° but is in opposite directions in these two meridians. There is no rotary deviation at 0°, 90° or 180°. Table I. One must remember that in the clinical use of the Jackson Cross Cylinder that this effect may be increased by a factor of two due to the "flipping" of the cross cylinder from position one to position two.

In the clinical application of the Jackson Cross Cylinder one wants an optical system which will induce the cross cylinder power functions but is free of differential magnification and rotary deviation effects. The typical Jackson Cross Cylinder consists of a spherocylinder with +0.50 diopters in one major meridian and —0.50 diopters in the other major meridian. Substituting the constants from Table II into equation 3, a magnification of 1.045 is found in the +0.50 diopter power meridian and 0.9545 is found in the —0.50 diopter power meridian.** Therefore there is a difference in magnification between the two major meridians of approximately 9%.

By setting $a = b = k_1$, equation 17 reduces to:

$$m = k_1 \left[\sin^2 (\sigma - \phi) + \cos^2 (\sigma - \phi) \right] = k_1 \quad (24)$$

TABLE II.

$t = 0.002$ meters	$F_1 (\phi + 90) = 0.00$
$h = 0.093$ meters	$F_v (\phi) = -0.50$
$n = 1.523$	
$F_1 (\phi) = 0.00$	$F_v (\phi + 90) = +0.50$

**These constants approximate those used in the design of the Jackson Cross Cylinders on one of the standard phoropters manufactured in this country.

This means that when one employs a uniform magnification lens, there will be no change in angular magnification as a function of the meridional angle. This obviously does away with the above criticism.

By setting $A = B = k_2$, equation 22 reduces to:

$$\text{Tan } \varsigma = O \qquad (25)$$

This means that when one employs a uniform magnification lens, there will be no rotary deviation or "scissors effect."

By designing the cross cylinder lens so that $a = b = k_1$ and $A = B = k_2$, one will have an optical system that will induce the cross cylinder power functions but will be free of differential magnification and rotary deviation effects.

It is possible to fulfill the above conditions by equating equation 3 for the ϕ and the $(\phi + 90°)$ meridians as follows:

$$\frac{1}{1-\left(\frac{t}{n}\right)F_{1(\phi)}} \quad \frac{1}{1-hF_{v(\phi)}} = \frac{1}{1-\left(\frac{t}{n}\right)F_{1(\phi+90)}}$$

$$\frac{1}{1-hF_{v(\phi+90)}} = k_2 \qquad (26)$$

One can substitute various values in equation 26 and solve for the unknown. By substituting the constants from Table III into equation 26, one come out with a uniform magnification lens. However, when one rotates this lens so that light is incident on the opposite surface there is an induced meridional difference in magnification of approximately 9%. At this point it looks as if our ideal system is impossible to design. However, if one employs two such lenses mounted in a suitable mechanical device such as that illustrated in Figure 5* then we again have our ideal system.

TABLE III.

$t = 0.0068$ meters	$F_1(\phi) = +10.00$
$h = 0.093$ meters	$F_1(\phi + 90) = -10.00$
$n = 1.523$	
$F_v(\phi) = -0.50$	$a \cong 0$, $\therefore A = 1$
$F_v(\phi + 90) = +0.50$	$b \cong 0$, $\therefore B = 1$

In addition, the optical principle of determining the power and axis of astigmatism with the cross cylinder is based on simple blur circle theory. The elimination of rotary deviation and differential

*Patent pending.

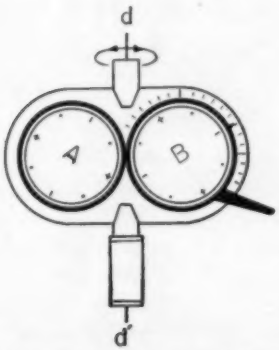

Fig. 5. Lenses A and B are mounted in such a manner that one can position either lens in any given meridian ϕ before the eye being tested. This mounting rotates around the axis dd' which enables the subject to view the test type first thru lens A and then thru lens B. The meridian ϕ is set by moving the small handle to the suitable position and reading the magnitude of ϕ from the axis scale. It is mechanically possible to use one lens controlled by a suitable trigger device which will instantaneously rotate the lens through 90° around its own optical axis.

magnification will increase the sensitivity of the test for the detection of small astigmatic errors.

In the past there has been no satisfactory clinical test for near point astigmatism. Fogging techniques are physiologically unsound. While the Jackson Cross Cylinder has so much distortion at near that it is impractical. The often used dynamic retinoscope also has many limitations. The Homokonic Cross Cylinder gives the clinician an astigmatic test at near point which is based on sound physiological optics principles.

SUMMARY

This analysis points out certain obvious optical phenomenon which result from the present design of the Jackson Cross Cylinder and which effect the clinical application of this optical device. Equations are derived to quantitatively analize and eliminate these effects. A mechanical mounting is illustrated which makes the clinical application of this system possible.

12 E. LOCUST ST.
NEWARK, OHIO

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A SERIAL STUDY OF REFRACTIVE STATUS IN YOUTH*

William R. Baldwin†
Division of Optometry, Indiana University
Bloomington, Indiana

INTRODUCTION

The averaging of refractive errors for various ages in cross sectional studies has suggested to many that children who are normally hyperopic up to the age of seven to ten years gradually become less hyperopic, or eventually become myopic. By a cross sectional study of over 5,000 school children between the ages of five and fourteen years, Hirsch[1] showed that the median refractive error changed less than did the mean error with increase in age. This indicates that, while a large portion of the subjects in that study may have shown little or no decrease in hyperopia, a lesser number were showing relatively rapid decrease in hyperopia (or increase in myopia).

Longitudinal studies such as those of Hofstetter,[2] and Bucklers[3] have supported Hirsch's conclusion that the skewness in the curves of refractive distribution at various age levels is the result of the influence of those few individuals who show a rapid progression into myopia. These studies have lent support to the concept that "myopia begets myopia."

PROCEDURE

The following data are taken from the serial case records of 78 patients and supplied from the files of two practicing optometrists.** The subjects were between the ages of six and twenty years at the time of the initial examination.

From these case records a number of correlations and trends were analyzed, among them the rate and direction of refractive change as measured by subjective procedure, with which the present discussion will be concerned.

The serial records of the individuals in this study were separated into two groups. One group contained those patients who showed empirically selected degrees of change in the subjective refraction of the

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†Research Fellow, American Optometric Foundation.
**George Meyer, O.D., Adrian, Michigan, and Ralph Ledrew, O.D., Edmonton, Alberta, Canada.

right eye over the period covered by the case record. A second group contained those in whom no change in terms of the same criteria occurred in this finding. The following criteria were used. Changes in either sphere or minus cylinder of one diopter or more were considered sufficient to indicate that a substantial change in refraction had occurred in any instance. In those patients exhibiting refractive errors of one diopter or less a change of one half diopter was considered substantial. Subjects meeting either of these two sets of criteria were placed in Group I. All others made up Group II.

For purposes of this study only the initial and final examinations were used unless more complete data at another examination indicated a better choice. Measures of central tendency and certain refractive characteristics were determined for both groups.

RESULTS

The criteria employed placed 44 or 56.5 per cent of the subjects in Group I, and 34 or 43.5 per cent in Group II. See Table I and Table II.

Group I. Twenty-two of the twenty-four hyperopes in Group I were hyperopic in both principal meridians. Two were mixed astigmats. Only one person labeled myopic in Group I was not myopic in both principal meridians ($0.00 = -0.50 \times 180°$). One hyperope and one myope in this group showed against-the-rule astigmatism, and one hyperope showed oblique astigmatism. The remaining 41 subjects displayed with-the-rule astigmatism.

Direction of change of right eye spherical component (using minus cylinder notation) in Group I is shown in Figure 1. It may be seen

TABLE I

	GROUP I	GROUP II
Age:	Years	Years
Mean	11.7	11.1
Median	11.8	10.8
Mode	10	10
Average Period Between Examinations	8.2	7
Refraction:	Number	Number
Hyperopes	24	28
Myopes	18	6
Emmetropes	2	0

TABLE II.

Comparison of hyperopes and myopes in Group I.

	Hyperopes	Myopes
Number showing cylinder	9	13
Per cent showing cylinder	37.5	72.2
Average cylinder	—1.00 D.	—1.12 D.
Average spherical component	+1.50 D.	—1.75 D.
Range (spherical component)	+0.25 to +9.75 D.	—0.25 to —5.00 D.

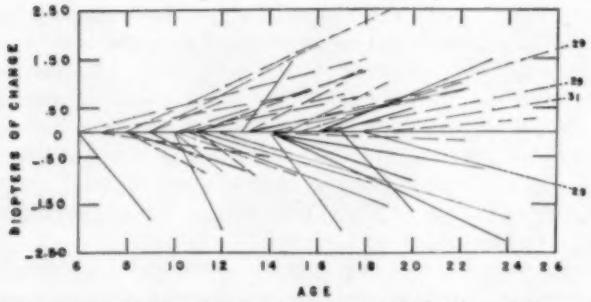

Fig. 1. The above graph demonstrates the amount and direction of change for those individuals in Group I. Subjects who were initially hyperopic are indicated by broken lines. Subjects who were initially myopic are indicated by solid lines.

from this graph that not only do most of the myopes in this study become more myopic, but most of the hyperopes who showed substantial change became more hyperopic. Of the twenty-four hyperopes in this group only one became myopic (+ 0.50 D. at 10 yrs. to — 0.25 D. at 15 yrs.); two showed a decrease in plus of the spherical component with no change in cylinder; while three showed a decrease in both sphere and cylinder. Nineteen showed an increase in plus of the spherical component. In nine of these the minus cylinder increased in magnitude.

All male subjects who were initially myopic showed an increase in myopia of the spherical component, as did six of the 11 females. Five females showed a decrease in the minus of the spherical component. Three myopes showed a decrease in cylinder amount, in all three 0.50 D. or less combined with a spherical component change of — 0.75 D. or greater.

Group II. There were no emmetropes in Group II. Three individuals showed mixed astigmatism and were numbered in the hyperopic group. The average spherical component of the right eye minus-cylinder lens formula for the myopes was — 1.92 D. The range was — 1.00 to — 4.00 D. The average spherical component for the hyperopes was + 2.02 D; the range: + 0.75 to + 4.50 D.

DISCUSSION

A comparison of the group showing change with the group showing no change suggests that, among hyperopic subjects at least, factors other than change in refractive status are of major importance in bringing patients into the optometrist's office. The similarity of the two groups with respect to age at the time of the initial examination also tends to support this thesis. The ratio of hyperopes to myopes in Group

I (24/18) compared with that of Group II (28/6) may indicate that change is a greater factor in leading the myope to seek visual care. While the higher average spherical component of both the hyperopes and the myopes in Group II as compared to the corresponding initial findings of Group I are of questionable significance statistically they may indicate that some members of Group II had already changed in a manner similar to the changes in Group I.

The relatively small number of hyperopes showing decrease in hyperopia may be due to the failure of those in this category to present themselves for examination during this period. However, the fact that a larger number showing no change sought visual care does not support this view. The similarity of the average spherical component of the hyperopes to that of the myopes in Group I is influenced by the following two factors: the range of the hyperopic cases was much greater (+ 0.25 to + 9.75); the myopic average was influenced more by the mode (— 1.25). The myopes' range was — 0.25 to — 5.50. The mode of the hyperopes was + 0.50.

The changes in the myopic group are for the most part consistent with the results of others. The hyperopic group's marked tendency to display greater hyperopia during this age period, however, requires further analysis. A possible explanation lies in the use of the cylindrical component which, in most cases, represented the horizontal meridian. That meridian for this group of subjects showed less tendency to increase in dioptric power than did the vertical meridian.* Further insight may be gained by reference to Sorsby's[4] conclusion that, "Cases showing a marked reduction in hyperopia are by no means common." Following this analysis, it could be presumed that many of the hyperopes who did decrease in their hyperopia were placed in the group showing no change because of the criteria employed. This aspect of refractive change deserves further study.

No attempt was made to estimate the therapeutic procedure applied at the time of the initial examination, therefore no factors based upon such procedures could be incorporated into the study. The initial and later spherical and cylindrical refractive components for both groups has been correlated with the ophthalmometer findings taken at these times. The results of this analysis will form the material for a later paper.

SUMMARY AND CONCLUSION

The 78 case records here studied were divided into two categories; those showing a substantial change in subjective refraction between

*Results to be published.

examinations and those who showed little or no change.

1. Myopes in the former group displayed cylinder almost two times as often as did hyperopes in this group (72.2% - 37.5%).
2. A larger percentage of myopes (75%) showed change as compared to hyperopes (45%).
3. Comparison of ratios of hyperopia to myopia in the two groups may indicate that hyperopia is more stable than is myopia or that the actual incidence is veiled because of the selectivity of the sample.
4. The direction of change for both hyperopes and myopes in the group showing change was highly predictable and in a direction which would increase the amount of the initial error.
5. The five individuals showing a decrease in minus were females having an average and median age greater than that of the remainder of this group. This suggests the possibility of a relationship between this factor and glandular changes occurring during puberty.

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RELATIONSHIP BETWEEN THE KEYSTONE VISUAL SKILLS TESTS AND THE SNELLEN CHART*

Milton Steinbaum†
Northport Public Schools

Mitchell Kurk‡
Jamaica, New York

INTRODUCTION

The most common method of screening students for poor vision in the schools is the acuity test in which the child reads a Snellen chart at a distance of twenty feet. This measures certain far-point skills only. It is common practice, however, to judge the child's overall visual condition from this test alone.

The present study is concerned with the relationship between the Keystone visual skills test to the Snellen chart test. This comparison was made in three respects. First, the subjects were tested on a Snellen chart, as well as with the Keystone battery, and a percentage score, equivalent to the Snellen rating for the poorer eye, was correlated with the percentage score devised for the Keystone test. Then, the advantages of both test instruments were also compared, since not all skills are measured by both: the Snellen measures three visual skills, far acuity of the right eye, left eye and both eyes; the Keystone measures eye muscle balance, visual acuity and depth perception. Finally, the number of failures found by each screening device was compared at two visual levels. A comparison was made between those children who scored less than 20/20 in the poorer eye on the Snellen chart to those who obtained a score of less than passing (94 to 0%) on the vision rating; the writers assumed these scores to be comparable. A comparison was also made between those children who scored 20/30 or below for the poorer eye on the Snellen to those who obtained a score of failing (87 to 0%) on the vision rating; the writers assumed these scores to be comparable.

Certain terms have been used in this study which should be defined to facilitate clarity:

1. Variables of Vision (Vision Skills)—refers to the Keystone Visual Skills Test, which consists of seven distance and five near tests:

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†Educator.
‡Optometrist.

At the Far Point

Test 1 (DB 10A)—a measure of simultaneous perception;

Test 2 (DB 8C)—a test for vertical phoria;

Test 3 (DB 9)—a test for horizontal phoria;

Test 4 (DB 4K)—a test of second degree fusion or the ability of the two eyes to fuse similar objects;

Test 5 (DB 3B)—a test of the visual acuity in the right eye under binocular conditions;

Test 6 (DB 2B)—similar to test 5, but is a measure of the visual acuity in the left eye under binocular conditions;

Test 7 (DB 6D)—a test for stereopsis.

At the Near Point

Test 10 (DB 9B)—a test for horizontal phoria;

Test 11 (DB 5K)—a test for second degree fusion;

Test 12 (DB 16)—a test for visual acuity in the right eye under binocular conditions;

Test 13 (DB 17)—a test for visual acuity in the left eye under binocular conditions;

Test 14 (DB 15)—a binocular measure of the visual acuity.

2. Keystone Telebinocular*—a stereoscopic instrument with which any desired distance in space may be simulated. The Telebinocular was used to simulate two points for this study:

A. Infinity—similar to the Snellen chart twenty foot distance;

B. Sixteen inches—similar to the near-point reading distance.

3. Kurk and Steinbaum Standard** (Vision score or rating)—a standard enabling a percentage score to be given for each child's vision, as judged from the Keystone screening test.

4. Visual Categories—three levels of visual performance utilizing the K-S Standard: these are: Passing (95-100%); Marginal (88-94%); Failing (0-87%).

In this study, 100 native-born children in the fifth and sixth grades of the Roslyn Heights School in Roslyn, Long Island, with an intelligence quotient of ninety and over were tested. The basic data were assembled with the approval of the principal of the Roslyn Heights School, and the District Superintendent of Schools. The Keystone

*The instrument used was the number 38 Telebinocular manufactured by Keystone View Company, Meadville, Pennsylvania.

**The Kurk and Steinbaum Standard will hereafter be referred to as the K-S Standard.

Tests were administered under the supervision of one of the authors (M. K.)

In reviewing the research, the writers found that various procedures were used for screening. The selection of the best type of skills test must necessarily depend upon the age, mental ability, and language development of the persons to be screened. Another important point is the time available for administering this test. As such, the Keystone Visual Skills Test was selected as the means for obtaining the minimum skills deemed necessary.

All children went through three phases of testing. The primary step was an interview to determine if the child wore glasses. No child was considered for the study if he wore glasses and did not have them at the time of the tests. The subjects were then tested on a Snellen chart, after which they were administered the skills test.

The Snellen scores, obtained during the second phase of the testing, were converted to a percentage basis, as devised by Sterling, Table 1.

TABLE 1.
Sterling Equivalents for Snellen Scores

Snellen Fraction	Efficiency in %
20/15 *	105
20/20	100
20/25	95.6
20/30	91.4
20/40	83.6
20/50	76.5
20/60	69.9
20/70	63.8
20/80	58.5
20/90	53.4
20/100	48.9
20/120	40.9
20/140	34.2
20/160	28.6
20/180	23.9
20/200	20.0

*The percentage equivalent for 20/15 was given by the writers, since Sterling does not consider this visual level.

The Sterling[6] score for the poorer eye was used for pearsonian correlations and comparisons. The selection of the poorer eye was made on the consideration that an examiner might refer a child for further examination on the basis of the poorest score obtained. This was felt to be a fair criterion for comparison with the Keystone when children are being considered for referral.

A new scoring procedure was devised for the Keystone test. Numerical grades were assigned to each skill so that a total vision score in percentage could be determined (the K-S Standard). The usual

method of grading the Keystone test battery is to check off all skills not falling within certain limits. Then, by inspection of the results, an opinion of the performance is made.

The writers felt that a numerical score would be more advantageous than the inspection method because: (1) it would facilitate statistical work; (2) ranges for the degree of visual status could be determined; (3) school and health officials could more easily understand visual performance on the basis of a percentage score.

The standards used were in keeping with the basic Keystone limits. All "expected" columns were given a score rating of "8," with the exception of test 7, which has a range of 6-8. This procedure would give a total maximum score of 96% for the twelve skills tested. It will be noted that, on the basis of 100% this standard has a discrepancy of 4%, all or part of which might be added to the child's score, depending on his quantitative and qualitative responses.

Precise measurements are not equally important for each skill. As such, greater latitude was given in some skills than in others. Thus, in tests 1, 3, and 10, the "doubtful" column received the same numerical score as the "expected" column. In the remaining tests, the "doubtful" column received a lower rating than the "expected." It will also be noted that in tests 5, 6, 12, 13, 14, it is possible, by the Keystone scoring system, to obtain a higher rating than that of the "expected" column. The writers take this possibility into account by adding part of the 4% leeway mentioned above to the total score. An additional criterion for use of the 4% leeway is facility of response by the child. For example, in tests 4 and 11, the accepted responses are: (a) perception of four circles and then three; (b) immediate perception of three circles.

The authors felt that the child in category "b" is more efficient in this skill than the former. Therefore, in addition to the score of 8 received, the child who fell into category "b" would deserve part of the 4% leeway. Furthermore, in tests 3 and 10, the stability of muscle balance is shown by lack of movement of an arrow. If the arrow was constantly in motion, this would be considered as not worthy of any additional compensation. The use of the 4% is left to the discretion of the examiner and has one reservation explained below.

In assigning visual categories the ratings were arranged so that a child failing completely in one skills test would necessarily fall out of the passing group. Due to the relatively narrow limits of the first two categories, partial failures of two or more skills would be sharply illustrated. Any child, however, who failed one skill with a score of 0% or received partial failures in two or more skills, was not considered

eligible for receiving any portion of the 4% leeway mentioned above. This prevented the possibility of a child's score from approaching or remaining in the passing category, when he exhibited visual deficiency.

Various studies have dealt with the relationship of the Snellen with other screening devices. A study by Kephart[2] of 2,181 school children showed that 541 were deficient in near acuity. Of this number, 42% had passed the far-point visual test. Thus, Kephart concludes that, if only a far-point test were administered 42% of the children who needed help would be classified as having met the visual standards.

According to Harris, Eames reported that in an examination of 100 children with visual defects the Snellen chart disclosed the presence of abnormality in only 48 children.[1] Also, Tiffin and Giese have shown statistically that there is little relationship between far acuity and near acuity in the adult population, while Kephart mentions that what is true of the adult population is also true of the school population.[2]

O'Shea, in a study of 1,150 children, considered 37% as passing, 26% as barely passing, and 37% as failing the screening test.[4] Scobee found that 46½ % of first and sixth grade children he examined to be in need of visual care.[3]

The writers were of the opinion that a study of this nature was justifiable for a number of reasons. The results of the study may lead to a reconsideration of present eye screening methods, whereby eye deficiencies of children could be detected and corrected in their early school years. This would help to prevent possible future difficulties for them in their reading and related school subjects. The task of the educator in teaching children might be made easier if restraining factors to effective learning, namely poor visual skills, are corrected before they become serious handicaps.

RESULTS

The correlation between the Snellen score and the K-S percentage score was found to be + 0.62, significant at the 0.01 level. Since a high score on the Snellen would yield a high score on the K-S Standard, far distance acuity ratings could be used to predict overall visual screening skills as measured by the telebinocular.

In comparing the number of visual failures picked out by both test instruments, the Snellen classified 48% as not having met the requirements of 20/20, while the Keystone classified 66% as not having met the requirements of passing (95-100%). This makes a difference of 18% more cases of failure found by the latter instrument. At the second level of comparison (20/30 or below) (and failing), the Snellen and Keystone uncovered 22% and 33% failures, respectively. This is

a difference of 11% more cases which the latter instrument uncovered as not meeting the visual requirements (see Table 3).

TABLE 2.
Percentage of subjects passing and failing the Keystone and Snellen tests at two comparable visual levels

	Level I		Level II	
	95-100% (K-S)	20/20 (Snellen)	88-100% (K-S)	Better than 20/30 (Snellen)
% Pass	34	52	67	78
% Fail	66	48	33	22

Putting this into more explicit terms, at the comparable levels of Passing (95-100%) on the Keystone and 20/20 on the Snellen, there were 25 children who passed the Snellen and failed the Keystone, and 8 subjects who failed the Snellen and passed the Keystone: this difference gave a chi square of 9.53 which is significant at the 0.01 level. The remaining 66 children either passed or failed both tests.

At the second level of comparison, 88-100% for the Keystone (which includes marginal and passing vision) and better than 20/30 for the Snellen, there were 19 children who passed the Snellen and failed the Keystone, and 7 subjects who failed the Snellen and passed the Keystone: this difference gave a chi square of 5.54 which is significant at the 0.02 level: the remaining 74 children either passed or failed both tests.

Thus, at both levels of visual performance, the Keystone test classified a significantly greater number of children as failing than did the Snellen. This indicates that the latter test, if used as a screening device, would fail to uncover some children who manifested visual deficiencies on the Keystone test.

As testing instruments, both the Snellen chart and Telebinocular have some comparable qualities and aspects. They are both quick and simple means of testing. Both are portable and can be administered by technicians with training in standard test procedures.

The Telebinocular offers additional values frequently not present in the Snellen test:

1. The light source is built in, thus making for constancy in illumination;
2. Provides for economy in testing space;
3. Provides visual measurements at both near and far points;
4. The distances of test objects are always constant;
5. The tests cannot be memorized by children waiting their turns to be tested;

6. It is a more comprehensive test measuring important functions of vision; acuity, phoria, and stereopsis;

7. In the opinion of the examiners the children enjoy taking the test.

The cost of the Snellen chart is approximately $1.00; the Telebinocular can be purchased for approximately $150.00.

Many of the seven objections to the Snellen test have been satisfactorily met by school nurses and could be met by others. In placing oneself in the position of a school nurse, or administrator, who for reasons of economy or other reasons, might wish to defend the Snellen test, the following objections might be raised:

1. The first objection of a light source being built into the instrument is met by the Massachusetts Test, which is based on the Snellen test;

2. The second objection of economy of space may not be a serious one in schools where school nurses have offices;

3. The third objection that only the Telebinocular offers measurements at near, is met by those who make Snellen measurements at near;

4. The fourth objection, that distances are always constant in the Telebinocular, but not in the Snellen, may not be valid at all times; since it may be noted that a difference of as much as a foot in Snellen testing is not as great an error as a difference of a centimeter, or so, in the Telebinocular;

5. The fifth objection, that of memorization of the test, may be met by school nurses, by using the E Chart and having the children who are to be tested wait outside the testing area;

6. The sixth objection is valid, but is met by the Massachusetts test which is not here discussed;

7. The seventh objection may be criticized by nurses who would point out that children also seem to enjoy taking the Snellen test.

Thus, in summary, objections to the Snellen test need not exist. However, in practice they often do.

DISCUSSION

In determining the type of visual screening needed, school officials would be interested in examining four areas: cost, personnel necessary, practicality, and values. The Keystone Telebinocular and the Snellen chart are discussed in these terms:

1. The Snellen chart is superior to the Keystone when cost is considered;

2. The average teacher can administer the Snellen with little

training, while the Telebinocular would necessitate some training in standard test procedures;

3. From the standpoint of praticality, the + 0.62 correlation between the Telebinocular and Snellen indicates that both test instruments yield comparable results. Neither test requires elaborate facilities; however, the Telebinocular provides for greater economy of space;

4. The comparison of values seems to point to the advantage of the Telebinocular over the Snellen. In addition to the previously reviewed advantages, the experimental procedures in this study demonstrate that the Telebinocular refers 18% more children than the Snellen.

From this 18% it is concluded that the Telebinocular uncovers more children who fail to meet the visual requirements than the Snellen test. It might be noted that these requirements are merely those of the test itself, and there is a possibility, therefore, that the Telebinocular is over-referring, and may not be the superior test.

The chance of over-referral, however, should not necessarily negate the significance of the 18%, since this datum might be of value to other researchers. O'Shea, in a study of 1,150 children, found that 37% passed and 37% failed in visual performance. The visual categories designed for the present study uncovered 34% of the subjects with passing vision and 33% with failing vision; these figures correspond closely with those of O'Shea.

In the selection of a screening instrument, where school officials are concerned with the problems of cost, personnel needed, and practicality, the Snellen chart is advantageous to the Telebinocular. However, if school officials are cognizant of the fact that the objections to the Snellen are not always met, and are also concerned with the 18% of of those children not uncovered by the Snellen, then the Keystone may be considered superior.

SUMMARY

This study was designed to determine the relationship between the Keystone Visual Skills Test with the Snellen chart. A group of fifth and sixth grade students was tested on each instrument, given scores in percent on each, and categorized as to visual status; percentage scores for the Keystone were determined by the Kurk and Steinbaum Standard; percentage scores for the Snellen were derived from the Sterling equivalents. The comparison of the instruments was made in three respects:

a. The relationship between the two percentage scores was determined;

b. The advantages of both instruments was compared;

c. The number of visual failures uncovered by each instrument was compared.

The following conclusions were determined:

1. There was a + 0.62 correlations between the Keystone and Snellen scores;

2. The Telebinocular uncovered as high as 18% more children, who failed to meet its visual requirements, than the Snellen;

3. The Snellen is advantageous to the Keystone when cost, personnel needed, and practicality are compared;

4. The Telebinocular is superior to the Snellen, when the objections to the latter test are not met.

88-22 179TH STREET
JAMAICA, NEW YORK

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Publication and Academy Office: 1508 Foshay Tower, 821 Marquette Ave.
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THE KEY TO PUBLIC RELATIONS

There is an aura of mystery surrounding the term public but actually the public is composed of individuals and many of these individuals are your patients. If certain, articulated relations with the public are desired, there is no better place to start than with the individual patients seen in day by day practice. In fact, a public relations program essentially founded on any other basis is untenable.

Everyone desires acceptance. This is true not only for individuals but also for groups of people such as social and fraternal organizations, states, nations, races, and even cultural and ethnic entities. It is also true for optometry.

There seldom is much difficulty about what is meant by acceptance. In a home, parents give acceptance to children by an atmosphere of love and understanding. In the office, practitioners give acceptance to patients by trying to keep appointments, patiently listening to case histories, and attempting to understand emotions and feelings regarding therapy and

eyewear. Similarily, groups of people manifest acceptance by various means. However regardless of where it is manifest, the usual connotation of acceptance is reception of a person or a group at *self* value.

Although there is widespread agreement about the meaning of acceptance, there appears to be very little concurrence of opinion on how it best might be achieved. This applies again at both the indivdual and group level.

Optometry desires acceptance by other groups in the healing arts. This is certainly a legitimate and desirable objective. However, of much more fundamental significance is the complete, full, unquestioned acceptance of the individual optometrist by his patients. This necessitates the kind of vision care that best suits the needs of the patient and not the kind of vision care that the patient will accept but which best meets the needs of the optometrist. When this need is met in full measure, it is the *key to public relations;* it is public relations at its best.

What kind of vision care should be provided for patients? The answer to this question will be obvious from several additional querries, namely: What model of automobile best meets the needs of transportation? If medicinal care is warranted for an illness is there preference for the latest, most effective drug or would there be reliance on useful though somewhat outmoded therapy? Do you prefer preparation of a dental cavity by the painless air-abrasive technique or by the time tested grinding procedure? Do many patients select frames generally used ten years ago? Obviously the latest and newest developments are desired and even rightfully demanded. The same answer also applies to the care of vision.

This is an age of science, of rapid change and development. Only several years ago the aeroplane was supreme; now guided missiles are commonly accepted. The conflagration of polio is classic; now it has joined the roster of other infectious diseases. The examples are innumerable and with modern communication the public is fully aware of them. People also expect improvements and advancements in the care of vision. They expect the solution to problems now which were unanswerable several years ago. They need greater visual efficiency, the application of the latest techniques in diagnosis and treatment, and adroit handling of pathology. In short, the patient has tremendous needs relative to vision. He expects, demands, and will obtain the very latest developments to meet his needs. It behooves optometrists to meet them and thus cultivate at every opportunity public relations at its best.

Next December, in Chicago, the Academy again will present fifty-

two (52) post-graduate courses in conjunction with its annual meeting. All of them are short in duration, i.e., one to twelve hours in length, and are offered in the three days preceding the regular meeting. Each instructor has made a detailed and careful study of the subject material in his own course or already is a specialist in his own right.

Any optometrist is eligible to register for one or any number of courses. It is *not* necessary for participants to be members of the Academy. Why don't you encircle the dates of December 4, 5, and 6 on your calendar and come to Chicago and take advantage of this opportunity to better meet the needs of your patients? See pages 511-522.

V. J. ELLERBROCK

SPECIAL REPORTS

DOCTOR DRAFT LAW EXPIRES: NEW LEGISLATION PROVIDES FOR SPECIALIST'S SERVICE*

Amendments to the Universal Military Training and Service Act, as amended, adopted in June, 1957, replace the former "Doctor Draft" law and provide for meeting the requirements of the Armed Forces for medical, dental, and allied specialists until July 1, 1959. Under the new amendments only those specialists who are otherwise liable as regular registrants are subject to induction under the Selective Service law.

The old "Doctor Draft" law under which medical, dental, and allied specialists had been liable since 1950 expired July 1, 1957. It had placed liability for service on older doctors, dentists, and allied specialists, at one time up to the age of 51.

One of the principal effects of the new amendments to the basic Selective Service law is to limit liability of doctors, dentists, and allied specialists to age 35 for those deferred on or after June 19, 1951; and to age 26 for others. Public Law 85-62, which amends the basic Selective Service law with respect to these specialists, was signed by the President on June 27, 1957. By placing medical, dental, and allied specialists under the same provisions of law and regulations as other registrants with respect to the upper limit of the age of liability, the 1957 amendments relieve from liability under the Universal Military Training and

*Reprinted in full from SELECTIVE SERVICE, Vol. VII, No. 8, pages 1-2. 1957. Washington, D. C.

Service Act, as amended, any such specialist over the age of 32 on the date the amendments became effective—July 1, 1957. This is true because in order to have acquired extended liability under the June 19, 1951, amendments, a registrant must not only have been deferred on or after that date, but also must not have attained the 26th anniversary of his birth by that date. Any man who was 26 on June 19, 1951, would, on July 1, 1957, have been 32 years old.

The amendments in addition provide that:

(1) No person in the medical, dental, and allied specialist categories shall be inducted if he applies for an appointment as a Reserve officer and is or has been rejected for such an appointment on the sole ground of physical disqualification.

(2) The President may order to active duty for not more than 24 consecutive months any member of a Reserve component who is such a specialist, who is under 35, and who has not performed at least 1 year of active duty in the Armed Forces.

(3) Any such person called or ordered to active duty from a Reserve component of the Armed Forces and who serves on active duty as a specialist for 12 months or more, shall upon release from active duty or within 6 months after release, be given an opportunity to resign the commission unless he is otherwise obligated to serve on active training and service in the Armed Forces or in training in a Reserve component by law or contract.

(4) Any physician or dentist qualified for a Reserve commission shall, so long as a need for his services exists, be given an opportunity to volunteer for active duty of not less than 24 months.

(5) The President may prescribe rules and regulations for the selection or induction of persons by age group or groups and for the selection and induction of persons qualified in needed medical, dental, or allied specialist categories pursuant to requisitions submitted by the Secretary of Defense.

(6) Qualified specialist aliens liable for induction shall not be held ineligible for appointment as commissioned officers solely on the grounds that such alien specialists are not citizens or have not declared their intention of becoming citizens.

(7) Any qualified person who is liable for induction, or who is ordered to active duty as a member of a Reserve component as a physician, or a dentist, or in an allied specialist category, shall be appointed, reappointed, or promoted to such grade or rank as may be commensurate with his professional education, experience, or ability provided

that any person in a needed medical, dental, or allied specialist category who fails to qualify for, or who does not accept, a commission, or whose commission has been terminated, may be used in his professional capacity in an enlisted grade.

(8) Periods of active duty performed by such specialists in student programs prior to receipt of appropriate professional degree or in intern training shall not be counted toward establishing the qualification of such specialists for classification as a veteran exempt from liability for training and service.

(9) It is the sense of Congress that the President provide for deferment of optometry students and premedical, preosteopathic, preveterinary, preoptometry, and predental students in numbers at least equal to the numbers of such male students now studying in colleges and universities.

(10) Public Law 62, 85th Congress, amending the Universal Military Training and Service Act, as amended, to provide service liability for persons in medical, dental, and allied specialist categories, expires on July 1, 1959.

With the expiration of the requirement for special registration of medical, dental, and allied specialists, such specialists under the amendments of June 27, 1957, should notify their local boards within 10 days of the attainment of degrees in these fields.

ANNOUNCEMENT

NOTES ON COMING ACADEMY PROGRAM

Dr. Ralph E. Wick, Rapid City, South Dakota, chairman of the Papers and Program Committee, American Academy of Optometry, reports that the four day Academy program scheduled for the annual meeting of the Academy, The Drake Hotel, Chicago, December 7-10, 1957, is now nearly completed. While all of the original papers which are expected have not as yet been scheduled, the following original papers will be presented by members and invited guests.

"Projection in Anomalous Correspondence." Neal J. Bailey, O.D., Ph.D., Division of Optometry, Indiana University, Bloomington, Indiana.

"Techniques for Measuring Astigmatism." Robert E. Bannon, O.D., D.O.S., Bureau of Visual Science, American Optical Company, Southbridge, Massachusetts.

"Contact Lenses for Psychosis and Neurosis." L. Lester Beacher, O.D., Sc.D., East Orange, New Jersey.

"Aspects of Cosmetic Dispensing Illustrated with Original Color Slides."

Margaret S. Dowaliby, O.D., Los Angeles College of Optometry, Los Angeles, California.

"Ophthalmographic Studies of Search." Jay M. Enoch, O.D., Ph.D., School of Optometry, The Ohio State University, Columbus, Ohio.

"Visual Aid to the Partially Blind—1957." William Feinbloom, D.O.S., Ph.D., New York, New York.

"Osmotic Effect of Lacrymal Fluid Determined by Summation Halometry." Isidore S. Finkelstein, O.D., Ph.D., New York, New York.

"The Empirical Longitudinal Horopter in Anomalous Correspondence." Merton C. Flom, O.D., Ph.D., School of Optometry, University of California, Berkeley, California.

"Test Objects for Astigmatic Checks and Orientation Experiments." Sylvester K. Guth, B.S., D.O.S., Radiant Energy Effects, Laboratory, General Electric Company, Nela Park, Cleveland, Ohio.

"Ojai Longitudinal Study—Report No. 1." Monroe J. Hirsch, O.D., Ph.D., Ojai, California.

"Convergence Accommodation." Comdr. Paul R. Kent, M.S.C., U.S.N., Naval Hospital, Great Lakes, Illinois.

"What the Motorist Sees While Driving on the Highway." A. R. Lauer, Ph.D., and Virtis W. Shur, Ph.D., Industrial Science Research Institute, Iowa State College, Ames, Iowa.

"The Theory and Application of the Bichrome Test." Robert Mandell, O.D., Division of Optometry, Indiana University, Bloomington, Indiana.

"Visual Problems of the Aged." Bernard Mazow, O.D., College of Optometry, University of Houston, Houston, Texas.

"Longitudinal Study of Refractive Changes in a Group Not Selected on a Visual Basis." Meredith W. Morgan, O.D., Ph.D., School of Optometry, University of California, Berkeley, California.

"A Scientific Approach to the Prescribing of Corneal Contact Lenses." Harold I. Moss, O.D., Wilmington, Delaware.

"The Relationship Between Measurements of Intelligence and Refractive Condition in a Selected Sample." Melvin C. Nadell, O.D., Ph.D., Los Angeles College of Optometry, Los Angeles, California.

"The Design of the Professional Office Suite." Marshall S. Olson, N. P. Benson Optical Company, Minneapolis, Minnesota, and Rudolph Ehrenberg, O.D., Granite Falls, Minnesota.

"The Professional Budget Plan." Marshall S. Olson, N. P. Benson Optical Company, Minneapolis, Minnesota, and Ralph E. Wick, O.D., Rapid City, South Dakota.

"Problems of Seeing at Night Driving Luminances." O. W. Richards, Ph.D., Research for Biology, American Optical Company, South-

bridge, Massachusetts.

"An Evaluation of the Children's Visual Achievement Forms at Grade I." Helen M. Robinson, Ph.D., Reading Clinic, University of Chicago, Chicago, Illinois.

"A Five Year Study of the Scholastic Aptitude and Reading Competence of Optometric Students." Alfred A. Rosenbloom, Jr., O.D., Illinois College of Optometry, Chicago, Illinois.

"Referrals from Visual Screening Procedures." Vernon Ryan, O.D., Pennsylvania State College of Optometry, Philadelphia, Pennsylvania.

"Sociological Perspectives of Optometry." John R. Uglum, O.D., Reno, Nevada, and Louis Orzack, Ph.D., Department of Anthropology, University of Wisconsin, Madison, Wisconsin.

"Accommodation Level During the Cross Cylinder Test." Gerald Westheimer, O.D., Ph.D., School of Optometry, The Ohio State University, Columbus, Ohio.

"A Study of the Relative Effect of Heredity and Environment Upon the Refractive Errors and Other Optical Characteristics of Identical Twins, Fraternal Twins and Like Sex Siblings." R. J. Wixson, O.D., Shamokin, Pennsylvania.

"An Estimate of the Hereditary Component of Myopia." Francis A. Young, Ph.D., School of Medicine, University of Washington, Seattle, Washington.

Additions to this list will be made and the completed program will appear in the November issue along with the outline of the program itself.

In addition to the foregoing, a three-hour symposium on orthoptics will be presented by the Academy on Sunday afternoon, December 8, at a joint meeting of the Academy and the Illinois Optometric Association at the Morrison Hotel, Chicago. The program for this symposium will be presented in the October issue.

The Section Programs will also appear in the October issue. Dr. Donald Springer, Anniston, Alabama, vice-chairman of the Papers and Program Committee, and the five Section Chairman, Dr. Oscar L. McCulloch, Holyoke, Massachusetts, *Section on Aniseikonia;* Dr. Bernard Mazow, Houston, Texas, *Section on Contact Lenses and Sub-Normal Visual Aids;* Dr. Herman Sager, Lake Success, New York, *Section on Occupational Optometry;* Dr. John Zettle, Jr., Cincinnati, Ohio, *Section on Orthoptics,* and Dr. Jay M. Enoch, Columbus, Ohio, *Section on Pathology* are now completing the individual programs for the Section meetings. These will come up to the usual high clinical standards set by the Sections.

CAREL C. KOCH

CURRENT COMMENTS

Terry Judith Parkins
Editorial Assistant

Optometrists will confer a favor by sending news items of general interest for this department; such as relate to new instruments, clinical techniques, education, visual health and optometric legislation and organization.

TWO OPTOMETRIC POST-GRADUATE COURSES ON GLAUCOMA

The Pennsylvania, New Jersey and Ohio Optometric Associations will co-sponsor two symposia on glaucoma. The first of these optometric post-graduate courses will be presented at the Pennsylvania State College of Optometry, Philadelphia, October 20, 1957. The second will be presented at the Hotel Roosevelt, Pittsburgh, November 10, 1957. Each will start at 11:00 A. M. and run throughout the day.

The symposia will be based on a review of glaucoma as it relates to optometric practice and the speakers will outline the newer optometric techniques used to aid in its early recognition. The speakers are all faculty members of the Pennsylvania State College of Optometry and will highlight a demonstration of the *phosphenator*, a new electronic instrument, designed for the early recognition of glaucoma.

Arthur Shlaifer, O.D., Ph.D., associate professor of optometry and ocular pathology will discuss the general topic of glaucoma relative to its incidence as regards age, sex, hereditary influences and basic etiology. A systematic review of chronic simple glaucoma and its diagnosis in the early stages will be emphasized with specific indication for use of optometric provocative tests in conjunction with scleral tonometry.

A complete review of the perimetric changes will be correlated with a clinical demonstration of the new *Harrington-Flocks perimetric screening test* will be presented by Harold Simmerman, O.D., professor of ocular pathology. This will be followed by a review of acute primary glaucoma of the congestive and non-congestive varieties.

The Wolfe scleral tonometer will then be presented with a report by William G. Walton, O.D., director of the eye clinics and assistant professor of optometry. This review will deal with the reliability, validity and clinical applicability as compared with the Schiotz corneal tonometer.

Isador Kaplan, M.D., chief consulting ophthalmologist to the eye clinics and professor of ocular therapeutics will present a comprehensive discussion on the medical and surgical treatment of glaucoma and will discuss the optometrist's role in the management of glaucoma.

Admission is limited to A.O.A. members and the registration fee at either post-graduate course will be $3.

CYCLOPLEGICS MONOGRAPHS REPRODUCED BY A.O.A.

During the summer the American Optometric Association has reproduced two former Academy monographs. These are (1) *The Use of Cycloplegics in Refraction* by Dr. Robert E. Bannon, and (2) *An Investigation as to the Need for "Drops" or Cycloplegics in Eye Examinations* by Dr. Carel C. Koch. Both papers appeared in former issues of this publication, and each has been out of print for some time. Mr. J. Harold Bailey, administrative director, A.O.A., writes that their motivation in reproducing these monographs was to again make them available to optometrists as the Academy had failed to do this. He believes they represent the best in the field and that the A.O.A. has received many requests from members for data on this subject. The Bannon monograph is available at 50 cents and the "Drops" monograph at 35 cents. Orders should be sent to the A.O.A. headquarters, 4030 Chouteau Ave., St. Louis 10.

WILLIAM HARVEY

In 1657 a British physician died. He was William Harvey, who in 1616 first discovered the circulation of blood. Most of his life was spent in making experiments to further prove his discovery yet during his lifetime he was generally ridiculed and never lived to see his discovery accepted by his colleagues. In fact the results of his researches were not generally accepted by physicians for many years after his death. Guthrie[1] in writing on some of the facts on Harvey's life says, "Now, let us turn to another aspect of Harvey's activity, namely, to the adventures of his famous book, and the curiously tardy acceptance of his great discovery. The *Anatomical Disquistion in the Motion of the Heart and Blood in Animals*, often called, for short, *De motu cordis*, published at Frankfurt in 1628, is a clear, brief, and logical account of the author's researches. As we read this little classic, the most important medical book ever written, we find the discovery so plainly set forth that we marvel that it was not immediately accepted. Indeed, the real significance of Harvey's work in the practice of medicine was not apparent for at least two centuries, and it took about 50 years before those best qualified to judge, the anatomists and scientists, appreciated its significance. Why this long delay in the acceptance of a truth so obvious? For the first part of the delay, the discoverer himself was responsible. Harvey lectured on the circulation for 12 years before putting his views in print. When his book did appear, many regarded Harvey as a crank."

[1]Douglas Guthrie. The Adventures of William Harvey and of His Discovery. International Record of Medicine. 170.6. 279-285. 1957.

The tercentennial of Harvey's death highlights this tragic experience. To be sure it is just one of many similar occurrences that have been recorded. Even in the advanced scientific period of the mid-twentieth century new ideas find much resistance and their general acceptance is usually a slow and discouraging process. Yet progress goes on due to the challenge that is presented to the trained inquiring mind.

NEWS BRIEFS

The American Optometric Association's annual conference on Motorist's Vision will be held at Chicago, October 18-19. The association's conference on Industrial Vision will also be held October 19-20. Both meetings will be in the Congress Hotel. . . . The American Optical Company has supplied 133 sight-screeners to the State of Indiana to be used for a continuing program of motorists' vision screening. The company also announces a new line of Schiaparelli designed spectacle frames for this Fall. . . . The IV International Congress of Contact Lens Specialists was held at Munich, Germany, during August. Dr. W. P. Sohnges was chairman and the following Academy members were among those who presented papers: Mr. Frank Dickinson, St. Annes-On-Sea, Lancashire, England; Mr. K. Clifford Hall, London, England; Dr. John C. Neill, Philadelphia, and Dr. N. K. Wesley, Chicago. . . . In August a production bonus of $66,000 was shared by all employees of the Titmus Optical Company except top executives. . . . Mr. A. E. Turville, former chairman of the British Chapter, American Academy of Optometry, has received the Research Medal of the British Optical Association for his many contributions to optometric science.

Dr. Paul Boeder, director of the Bureau of Visual Science, American Optical Company, has resigned. He has joined the Department of Ophthalmology of the College of Medicine, State University of Iowa. . . . Dr. Kenneth Ogle, Mayo Clinic, Rochester, Minnesota, and Mr. Theodore Obrig, New York City, will receive the Beverly Myers Nelson Achievement Awards at the October 14 meeting of the American Board of Opticianry in Chicago. . . . The Shuron Optical Company announces a new line of children's frames, these being small reproductions of already popular frames made by Shuron for women and men. . . . The Middle Atlantic Optometric Congress will be held at the Roosevelt Hotel, Pittsburgh, October 6-8. . . . The coming annual meeting of the Illinois Optometric Association, Morrison Hotel, Chicago, December 7-9, will be the Golden Anniversary Convention of the association. . . . The Keystone View Company has just concluded a week-long post-graduate course for optometrists in New York City. The course dealt with problems of the accommodative-convergence relationships and the or-

thoptic care needed in these cases. Thirty optometrists were in attendance. . . . Mr. Norman Bier, optometrist and contact lens specialist of London, England, will visit the States late this year. He will make several talks and it is expected that he will address the Academy at its annual meeting in Chicago, December 4-10. Mr. Bier is active in the British Chapter of the Academy in England.

The Apex Specialties Company, Providence, has introduced a new picto-scope anamorphic lens for motion picture cameras and projectors that increases the width of the picture by 50%. . . . At the September 18 meeting of the New Jersey Chapter, American Academy of Optometry, the following members were scheduled to speak: Dr. Nathan Flax, "An Introduction to Space Orthoptics," and Dr. Ralph B. Gaeta, "The Use of a Simplified Astigmometer." . . . Dr. Richard Feinberg, assistant to the president, Titmus Optical Company, was one of the speakers at the Lighting Seminar, Portland, Oregon, in August. . . . The next annual Reading Institute at Temple University, Philadelphia, will be held January 27-31, 1958, at the Reading Clinic. Optometrists are especially invited to attend. . . . The convention of the Ohio State Optometric Association will be at Dayton, Biltmore Hotel, October 27-28. . . . The Optometric Extension Program has announced an increase in the subscription fee for their monthly papers of from $48 to $60 per year.

The third annual invitational Bradford Woods Conference on Optometry will be held October 16-17 at Bradford Manor, Martinsville, Indiana. The conference program is being arranged by Dr. Robert W. Tubesing, Richmond, Indiana, and Dr. Henry W. Hofstetter, Bloomington, Indiana. Registration will be limited to 25 optometrists. . . . Dr. Eugene W. Strawn, president, Illinois College of Optometry reports that 70 new undergraduate optometry students were enrolled at the College on the first day for registration early in September. A number of additional students were expected during the first week of school. . . . Dr. Arthur Tillisch, president of the Minnesota Optometric Association, has announced that 264 Minnesota optometrists registered at the post-graduate courses dealing with early recognition of glaucoma which were held in five Minnesota cities early in September. Dr. Jay M. Enoch, member of the faculty, School of Optometry, The Ohio State University, Columbus, Ohio, conducted the courses.

TRANSACTIONS OF THE ACADEMY
AMERICAN ACADEMY OF OPTOMETRY

A department devoted to announcements, reports, appointments, organization data, news, professional problems and ideals, as these relate to the Academy.

AMERICAN ACADEMY OF OPTOMETRY

POST-GRADUATE COURSES

Drake Hotel
Chicago, Illinois
December 4, 5, 6
1957

Committee on Instruction
V. J. Ellerbrock, Chairman
H. M. Fisher
G. Westheimer

Committee on Administration
D. G. Hummel, Chairman
R. Ehrenberg
M. H. Kauhl

GENERAL INFORMATION ON POST-GRADUATE COURSES

Time: All courses are scheduled for the three days immediately preceding the regular annual meeting of the Academy.

Place: All of the courses will be taught in the Drake Hotel.

Applicants: Any optometrist may apply for one or more courses.

Cancellation: In case of cancellation by applicant the fee will be returned, providing such cancellation is received no later than November 16, 1957.

Cost: The cost per hour of instruction is $2.00 unless otherwise specified.

Enrollment: For most of the courses the enrollment is limited to 30. Several very specialized courses, however, are limited in enrollment as indicated in the description of the courses.

Number of Courses: Fifty-two (52).

Hours of Instruction: One hundred and twenty-four (124).

Applications: All applications should be sent to Dr. D. G. Hummel, The National City Bank Bldg., Cleveland, Ohio.

Deposit: One-half the total fee for each course must accompany the application. The balance must be paid at the commencement of the courses. The courses designated with an asterisk (*) are limited in enrollment. Applications for these courses must be accompanied by the full fee.

Tickets: Without exception, everyone enrolled in a course must register and pick up the appropriate ticket. Without it, no one can be admitted.

Lecture Rooms: These will be posted at the registration desk. The hotel bulletin board will state the location of the registration desk. Please check your time schedule of courses. The Committee cannot be responsible for conflicts of scheduling.

KEY TO DESIGNATION OF PERIODS

Time	Wednesday	Thursday	Friday
8:00 A.M.	W-8	T-8	F-8
9:00	W-9	T-9	F-9
10:00	W-10	T-10	F-10
11:00	W-11	T-11	F-11
12:00	W-12	T-12	F-12
1:00 P.M.	W-1	T-1	F-1
2:00	W-2	T-2	F-2
3:00	W-3	T-3	F-3
4:00	W-4	T-4	F-4
5:00	W-5	T-5	F-5
8:00	W-E	T-E	F-E

Note: In program of Courses, (E) denotes 8:00 P.M Evening Course.

Course 1
Subjective Testing Procedures
Merrill J. Allen, O.D., Ph.D.
Bloomington, Indiana
A two-hour course—$4.00
Periods: F-2, F-3

A review of subjective test procedures used in an eye examination with special consideration of some of the more frequent sources of error and causes of test failure. The following tests will be covered: visual acuity, binocular balance tests, astigmatism tests at distance and near, bichrome test and the effects of distance test criteria on the near test findings.

Course 2
Efficiency in the Optometric Examination
Merrril J. Allen, O.D., Ph.D.
Bloomington, Indiana
A two-hour course—$4.00
Period: F-E

An evaluation of the purpose of an optometric examination and of the tests constituting an examination. A breakdown of the examination into the time required for its components with emphasis on streamlining by test grouping, eliminating waste motion and faulty questioning.

Course 3
Accounting and Taxation Practices for Optometrists
Leonard Schanfield, LL.B.
Chicago, Illinois
A three-hour course—$6.00
Periods: W-8, T-8, F-8

The professional man in private practice is in many respects in a unique position with regard to taxation regulations. The special advantages and disadvantages will be described and recommended practices will be outlined.

Course 4
Phorias — Physiological Considerations and Practical Applications
Mathew Alpern, O.D., Ph.D.
Ann Arbor, Michigan
A two-hour course—$4.00
Periods: T-4, T-5

Course will be devoted to a study of the behavioral and physiological factors which influence the magnitude of the phoria measurement. Recent studies of the basic characteristics of the phoria position will be reviewed and the application of such information to clinical practice will be emphasized. A comparative analysis of various phorometry techniques will be made and the problems and pitfalls in applying phoria data to arrive at the prescription will be pointed out. Emphasis will be on horizontal phoria measurements but a brief discussion of the problems of vertical phorias will be presented also.

Course 5
Recent Advances in Visual Science
Mathew Alpern, O.D., Ph.D.
Ann Arbor, Michigan

SCHEDULE OF COURSES BY HOURS

Hour	Wednesday (W)	Thursday (T)	Friday (F)
8:00 A.M.	3 51 36	3 51 23	3 18 29
9:00 A.M.	32 34 36	32 34 28	24 18 29 41
10:00 A.M.	27 43 31 15	27 43 35 15	6 5 45 17
11:00 A.M.	27 43 31 15	27 43 35 15	6 5 45 17
12:00 noon	38 49 39	38 14 50	25 48 26 33
1:00 P.M.	9 49 35	10 48 50	11 48 26 33
2:00 P.M.	27 43 47	27 43 47 42	12 1 52 16
3:00 P.M.	27 43 47	27 43 47 42	12 1 52 42
4:00 P.M.	21 8 40	21 13 4 46	21 7 19
5:00 P.M.	22 37 50	22 37 4 46	22 37 19
8:00 P.M.	30 44 20	30 44 20	30 44 2

A two-hour course—$4.00

Periods: F-10, F-11

A review of theoretical and experimental results of recent publications in the field of visual science and physiological optics will be presented. Emphasis will be placed on those works which seem most likely to have a lasting effect upon future thinking and clinical practice. These will include work in visual physiology, movements of the eyes and their relation to the visual act, accommodation, convergence, pupil size, and visual psychophysics. Work which especially points out deficiencies in our current theoretical positions will be discussed and wherever possible the direction of revision of theory will be indicated.

Course 6
Refraction of the Pre-School Child
Neal J. Bailey, O.D., Ph.D.

Bloomington, Indiana

A two-hour course—$4.00

Periods: F-10, F-11

Clinically tested examination and office handling techniques useful for very young children will be presented.

Course 7
Sunglasses
Neal J. Bailey, O.D., Ph.D.

Bloomington, Indiana

A one-hour course—$2.00

Period: F-4

A brief discussion of the physiological effects of radiant energy upon the visual mechanism with special emphasis on the clinical applications of absorptive lenses will be presented. Similarities and differences between commercially available sunglasses will be demonstrated.

Course 8
Space Eikonometer Technique of Measuring Aniseikonia
Robert E. Bannon, O.D.

Southbridge, Massachusetts

A one-hour course—$2.00

Period: W-4

The course will be devoted to the step-by-step procedure of measuring aniseikonia with the Space Eikonometer. The presentation will include not only the technique for the usual patients but also for the more complicated cases which have difficulty in making reliable responses. The material will be practical and based upon actual clinical experiences. Specific questions germane to the technique of measuring aniseikonia may be submitted at the beginning of the hour and will be discussed during the course.

Course 9
Clinical Judgment in Prescribing Aniseikonic Corrections
Robert E. Bannon, O.D.

Southbridge, Massachusetts

A one-hour course—$2.00

Period: W-1

Designed as a complement to Course 8. This course will consider what should be done with the measurements, i.e., what Rx should be prescribed. Partial corrections, spherical equivalents, and approximations resulting from changes in base curves and thicknesses will be discussed. Actual case histories, including data on what was measured and what was prescribed, will be reviewed and questions submitted at the beginning of the hour will be considered.

Course 10
Management of Difficult Refractive Problems
Robert E. Bannon, O.D.

Southbridge, Massachusetts

A one-hour course—$2.00

Period: T-1

Unrelieved symptoms and unsatisfactory refractive findings may be considered as "difficult refractive problems." Symptoms and history will be discussed from the standpoint of visual, ocular, and referred disturbances. A review of auxiliary investigations will include comparison of astigmatic chart versus cross-cylinder findings, binocular refractive techniques, cyclodamia and cycloplegia, accommodative astigmatism, monocular occlusion and binocular anomalies.

Course 11
Practical Aspects of Multifocal Corrections
Robert E. Bannon, O.D.
Southbridge, Massachusetts
A one-hour course—$2.00
Period: F-1

Procedures for determining the addition for various working distances, indications for temporary or diagnostic corrections, and considerations necessary in anisometropic and heterophoric cases will be reviewed. The optical features, image jump, object displacement, size of reading field, and ranges of clear vision will be discussed together with some points on analysis of occupational requirements. Many difficulties in a patient's adjustment to his multifocal correction can be prevented by proper attention to those factors.

Course 12
Evaluation of School Testing Procedures
Lois Bing, O.D.
Cleveland, Ohio
A two-hour course—$4.00
Periods: F-2, F-3

A discussion of methods and instruments for screening school children's vision and procedures for evaluating findings and follow-up. This course will be of particular value to optometrists who may be called upon to participate in screening programs in schools.

Course 13
Review and Evaluation of Reminder Systems
Paul L. Connolly, O.D.
Royal Oak, Michigan
Milton Hathaway, O.D.
Pontiac, Michigan
A one-hour course—$2.00
Period: T-4

Reminder systems have proven to be a very important part of many successful practices. The design of a number of the most popular ones will be explained in detail. This will include data on frequency of mailing, effectiveness, use of postage meter as well as use of other office mailings.

Course 14
Signs and Symptoms of Aniseikonia
Paul L. Connolly, O.D.
Royal Oak, Michigan
A one-hour course—$2.00
Period: T-12

Every new refractive correction produces changes in the ocular images and in the conditions under which the patient sees. Whether these changes are clinically significant depends not only upon their magnitude but also upon the patient's tolerances and his psycho-physical characteristics. These factors will be discussed and evaluated in the light of several years' experience. This discussion will lead to helpful clues for suspecting aniseikonia as a possible cause of headaches, asthenopia, and other visual disturbances.

Course 15
Streak Retinoscopy
J. C. Copeland, O.D.
Chicago, Illinois
A four-hour course—$8.00
Periods: W-10, W-11, T-10, T-11

This course is intended for those who wish to improve their skills in objective testing. Many new innovations in teaching the Streak Technique will make the course of special interest to both those who now use the Streak Retinoscope and those who desire to begin its use. Each student will be provided with all necessary equipment including a retinoscope, schematic eye, transformer and lenses. The course is conducted so as to give each man personal supervision and instruction as well as lectures for the group.

Course 16
Dispensing Eyewear for Children
Margaret S. Dowaliby, O.D.
Los Angeles, California
A one-hour course—$2.00
Period: F-2

A description of new ophthalmic materials available for children including lenses, frames and assorted accessories. Practical applications will be emphasized.

Course 17
Color in the Feminine Wardrobe
Margaret S. Dowaliby, O.D.
Los Angeles, California
A two-hour course—$4.00
Periods: F-10, F-11

A complete discussion of the importance of color as related to eyewear from two viewpoints: the patient's own coloring and a consideration of wardrobe.

Course 18
Case History
Jay M. Enoch, O.D., Ph.D.
Columbus, Ohio
A two-hour course—$4.00
Periods: F-8, F-9

The methods of pin-pointing the patient's visual problem will be discussed, and a classification of objective and subjective symptoms will be presented. In addition, the problem of putting the patient at ease and eliciting his cooperation will be reviewed. Consideration will be given to the importance of the practitioner's first estimate of the case, and the organization of the remainder of the examination.

Course 19
Ocular Manifestations of Diseases of the Central Nervous System
Jay M. Enoch, O.D., Ph.D.
Columbus, Ohio
A two-hour course—$4.00
Periods: F-4, F-5

One of the most important responsibilities of an optometrist is the early recognition of diseases of the central nervous system and proper referral of such cases. The detection, recognition and prognosis of these diseases will be discussed. The conditions will be described and their interference with ocular motility and vision will be considered.

Course 20
Optometric Applications of Vision Testing Programs in Highway Safety and Industry
Richard Feinberg, O.D., Ph.D.
Petersburg, Virginia
Reuel A. Sherman, D.O.S.
Petersburg, Virginia
A four-hour course—$8.00
Periods: W-E, T-E

Review and new considerations for optometrist entering Highway Safety and Industrial Eye Care Programs. Techniques of organization and operation. Slide and instrument demonstrations.

Course 21
Visual Rehabilitation of the Partially Blind
William Feinbloom, O.D., Ph.D.
New York, New York
Irving P. Filderman, O.D.
Memphis, Tennessee
C. Edward Williams, O.D.
Denver, Colorado
A three-hour course—$12.00
Periods: W-4, T-4, F-4
Enrollment limited to 15.

This course will present the role of the optometrist today in the field of rehabilitation. The history, purpose, and present organization of the blind and partially blind agencies in this work will be reviewed.

It has now been amply demonstrated that it is desirable for optometrists to be associated with these agencies. The *Modus Operandi* for such cooperation will be explained. The sociological, psychological, and education problems involved with various optical aids also will be presented.

Course 22
Sub-Normal Vision Clinic
William Feinbloom, O.D., Ph.D.
New York, New York
Irving P. Filderman, O.D.
Memphis, Tennessee
C. Edward Williams, O.D.
Denver, Colorado
A three-hour course—$12.00
Periods: W-5, T-5, F-5
Enrollment limited to 15.

A clinical program designed to present and analyze problems encountered in sub-normal vision cases. The application of visual aids in caring for partially sighted patients will be covered in detail.

Course 23
The Role of Aniseikonia in Optometric Practice
Benton C. Freeman, O.D.
Allentown, Pennsylvania
A one-hour course—$2.00
Period: T-8

Based upon 15 years experience in the measurement and correction of aniseikonia, the value of being able to measure image size differences in routine optometric practice will be discussed and augmented by illustrative case reports. Some of the problems and pitfalls in applying aniseikonia data to arrive at a prescription will be presented with observations relative to the personal satisfaction of handling aniseikonic patients.

Course 24
Evaluation of Quality in Ophthalmic Lenses
G. A. Fry, O.D., Ph.D.
Columbus, Ohio
A one-hour course—$2.00
Period: F-9

For several years the speaker has been Chairman of the Standards Committee of the A.O.A. and represents Optometry on an American Standards Association Committee on spectacle lenses. He will demonstrate methods of testing ophthalmic lenses for quality and show what defects cannot be permitted and how such defects can be most readily detected.

Course 25
Testing Stereopsis
Glenn A. Fry, O.D., Ph.D.
Columbus, Ohio
A one-hour course—$2.00
Period: F-12

A description of the various methods of measuring stereoscopic acuity will be provided. Attention also will be given to the effect of accommodation, convergence, training and optical systems on this function.

Course 26
Amblyopia
Ernest Giglio, O.D.
Bernardsville, New Jersey
A two-hour course—$4.00
Periods: F-12, F-1

One of the most prominent problems in optometric practice is the decision whether a patient with amblyopia can be helped. This course is designed to provide an up-to-date review of diagnostic procedures and of methods of training, with special emphasis on the probability of success.

Course 27
Advanced Course in Contact Lenses
Robert Graham, O.D.
Pasadena, California
William Feinbloom, O.D., Ph.D.
New York, New York
John Neill, O.D.
Philadelphia, Pennsylvania
William Policoff, O.D.
Wilkes-Barre, Pennsylvania
An eight-hour course—$32.00
Periods: W-10, W-11, W-2, W-3, T-10, T-11, T-2, T-3
Enrollment limited to 12.

Techniques for maximum success in the fitting of modern contact lenses. The course includes a thorough exposition of the methods for securing optimum results in regular cases, as well as procedures employed in handling the more complicated and difficult problems. The course is for those who already have substantial experience in the fitting of contact lenses.

Course 28
Basic Factors in Space Perception
Salvi S. Grupposo, O.D.
Southbridge, Massachusetts
A one-hour course—$2.00
Period: T-9

A review will be given of the factors in normal space perception or spatial localization with particular reference to the role of stereopsis. This will be followed by a discussion of the distortions in the stereoscopic perception of space, the effects of aniseikonia, and clues for its detection in routine optometric practice.

Course 29
The Effect of Radiation on the Eye
Sylvester K. Guth, E.E., D.O.S.
Cleveland, Ohio
A two-hour course—$4.00
Period: F-8, F-9

Sources of radiant energy, spectral distribution units of measurements. Physiological and psychological effects of radiant energy from various spectral regions including the non-visual spectrum and nuclear radiation. Possible methods of eye protection and the role of the optometrist in this connection will be reviewed.

Course 30
Ocular Pathology Review
Organized by the Section on Pathology American Academy of Optometry

Members of the Section will participate during the 3 two-hour evening periods.

M. J. Hirsch, O.D., Ph.D.
A six-hour course—$12.00
Periods: W-E, T-E, F-E

Course 31
Current Thinking in Myopia
M. J. Hirsch, O.D., Ph.D.
Ojai, California
A two-hour course—$4.00
Periods: W-10, W-11

A viewpoint concerning the many theories on myopia is slowly emerging. A discussion will be presented of new experimental findings and current thinking with a view to its practical application to the myopic patient.

Course 32
Recommended Insurance Practices for Optometrists
Myron Hecht
Chicago, Illinois
A two-hour course—$4.00
Period: W-9, T-9

There has been a spectacular growth in practically all types of insurance in the last several years. It is highly desirable, even quite necessary, for optometrists to have some types while quite incidental to purchase other forms. These will be evaluated. A basic insurance program for the optometrist also will be described.

Course 33
The Role of Eye Movements in Visual Acuity
Henry A. Knoll, Ph.D.
Los Angeles, California
A two-hour course—$4.00
Periods: F-12, F-1

Two recent developments relating to eye movements and their relationship to visual acuity lead to important theoretical and practical considerations. The first of these developments relates to the role played by eye tremors in maintaining high retinal resolution. The second development concerns the measurement of visual acuity during following eye movements, i.e., dynamic visual acuity. The most recent advances in these two fields will be reviewed and their significance discussed.

Course 34
Vertical Heterophorias
J. Donald Kratz, O.D.
Souderton, Pennsylvania
A two-hour course—$4.00
Periods: W-9, T-9

A discussion of vertical heterophoria with emphasis on the differentiation of the concomitant and noncomitant types. A careful analysis of the methods of handling the progressive and stationary noncomitant types will be presented.

Course 35
Psychological Problems in Optometric Practice
Russell H. Levy, Ph.D.
A three-hour course—$6.00
Periods: W-1, T-10, T-11

(1) The organically affected patient. (2) The neurotic patient. (3) The psychotic patient. How to handle such patients when situation arises, and how to refer them to proper channels.

Course 36
Vision Training Procedures with the Correct-Eye-Scope
Leo Manas, O.D.
Chicago, Illinois
A two-hour course—$4.00
Periods: W-8, W-9

(a) Cheiroscopic Drawing—procedure, target modification, and results of training. (b) Van Orden Star—procedure, target modification, and results of training.

Course 37
Recent Advances in the Diagnosis, Prognosis and Treatment of Strabismus
Meredith W. Morgan, O.D., Ph.D.
Berkeley, California
A three-hour course—$6.00
Periods: W-5, T-5, F-5

Discussion of precise methods of determining the state of binocular vision in strabismus, the factors which must be considered in making a prognosis, the recognition of anomalous fixation and methods whereby normal binocular vision may be restored in favorable cases.

Course 38
The Turville Infinity Binocular Balance Test
Meredith W. Morgan, O.D., Ph.D.
Berkeley, California
A two-hour course—$4.00
Periods: W-12, T-12

The Turville method of determining the subjective refractive error of each eye while maintaining single binocular vision. The prescribing of vertical and base-in prisms with this method.

Course 39
House Calls and Visual Care of the Invalid Patient
Thaddeus R. Murroughs, O.D.
Santa Barbara, California
A one-hour course—$2.00
Period: W-12

The course covers the methods of rendering visual care to the invalid. Sample letters to prospective referees and a check list of minimum equipment is provided. Special refracting considerations are evaluated with respect to the degree and type of infirmity. Various methods of prescribing corrections are related to the type of illness, degree of acuity and degree of immobility.

Course 40
Unfavorable Prognostic Pointers in the Cure of Strabismus
Thaddeus R. Murroughs, O.D.
Santa Barbara, California
A one-hour course—$2.00
Period: W-4

Sixteen adverse features found in strabismus therapy are presented. A method of identifying and evaluating each of these handicapping conditions is presented. The aim is to furnish a method for screening out those cases which are unfavorable orthoptic risks.

Course 41
Therapeutic Procedures in Aphakic Patients
Thaddeus R. Murroughs, O.D.
Santa Barbara, California
A one-hour course—$2.00
Period: F-4

The spatial problems of the aphakic patients are described from the standpoint of magnification and role of vertex distance. The refractive and dispensing routine and aftercare are discussed with respect to instrumentation, lens tilt, center thickness, base-curves, and consideration in the selection of the prescribed lens. A complete outline is provided.

Course 42
Orthoptics for Strabismus Patients
Thaddeus R. Murroughs, O.D.
Santa Barbara, California
A three-hour course—$6.00
Periods: T-2, T-3, F-3

An overall outline of practical training procedures is presented and reviewed. Reasons for failure are stressed in order of importance. The fundamental training procedures are illustrated in terms of the objectives to be achieved. The peripheral field approach to orthoptics will be stressed. Training procedures are presented in terms of principles with specific examples on various instrumentations.

Course 43
Beginning Contact Lens
John Neill, O.D.
Philadelphia, Pennsylvania
and associates
An eight-hour course—$32.00
Periods: W-10, W-11, W-2, W-3,
T-10, T-11, T-2, T-3
Enrollment limited to 12.

For this course, the assumption is made that the practitioner has no prior experience with contact lenses. A comprehensive study will be made therefore of the principles, design and fitting of modern contact lenses. A considerable part of the course will be devoted to practical instruction of fitting, insertion and removal.

Course 44
Subnormal Vision
William Policoff, O.D.
Wilkes-Barre, Pennsylvania
Alfred Rosenbloom, Jr., O.D.
Chicago, Illinois
A six-hour course—$24.00
Periods: W-E, T-E, F-E
Enrollment limited to 15.

This course will cover all aspects of this problem such as definition, causes, psychological factors, examination, placement in sight saving classes, etc. Various aids will be described and pertinent facts on their use will be presented. The role of the itinerant teachers' program also will be reviewed as well as the programs of rehabilitation of the partially blind.

Course 45
The Early Detection of Ocular Pathology
Jack H. Prince, F.B.O.A.
Columbus, Ohio
A two-hour course—$4.00
Periods: F-10, F-11

Color illustrations of pathological conditions, differential diagnosis and discussion of early symptoms.

Course 46
The Use of the Slit Lamp in Diagnosis
Jack H. Prince, F.B.O.A.
Columbus, Ohio
A two-hour course—$4.00
Periods: T-4, T-5

Discussion and color illustrations of normal and pathological conditions as seen through the slit lamp microscope. Emphasis will be given to the study of diabetes with this instrument, and to the anticipation of glaucoma on the basis of anatomical structure.

Course 47
The Optometrist's Relationship to the Reading Program
Alfred A. Rosenbloom, O.D.
Helen M. Robinson, Ph.D.
Chicago, Illinois
A four-hour course—$8.00
Periods: W-2, W-3, T-2, T-3

A brief presentation of the process of learning to read from the readiness period to maturity, with an opportunity to learn a new alphabet.

Presentation of the diagnosis of a retarded reader in which the contribution of the optometrist to the solution of the problem is clarified.

Course 48
Graphical Analysis
Max Schapero, O.D.
Los Angeles, California
A three-hour course—$6.00
Periods: T-1, F-12, F-1

An introduction to the principles of graphic analysis, with emphasis on the plotting of optometric data on the analytical graph, the detection of faulty findings, and the understanding of the basis of case analysis and prescription.

Course 49
Recent Advances in the Technique of Fitting a Ptosis Crutch
Paul F. Shulman, O.D.
Chicago, Illinois
A two-hour course—$4.00
Periods: W-12, W-1

The problem of ptosis will be discussed relative to its etiology and prognosis. The specific procedure for fitting a ptosis crutch will be demonstrated on a patient. The different means of attachment of a ptosis crutch to various types of frames will be demonstrated and the different types of wire used will be exhibited. A ptosis crutch will be made in the classroom from start to its final fitting on the patient's face. Pictures of before-after results will be shown and discussed. Printed material outlining the procedure will be distributed.

Course 50
Scleral Tonometry and Glaucoma
Paul F. Shulman, O.D.
Chicago, Illinois
A three-hour course—$6.00
Periods: W-5, T-12, T-1

A thorough discussion of glaucoma. Existing literature and research in the field of scleral tonometry will be reported and summarized. The specific use of the scleral tonometer will be described in detecting abnormal variations of intra-ocular pressure. Instruments will be available for members of the class to use on each other.

Course 51
Migraine
Harold Simmerman, O.D.
Wenonah, New Jersey
A two-hour course—$4.00
Periods: W-8, T-8

Migraine represents the single cause of a substantial percentage of headaches that confront the optometrist in routine practice. This course will be designed to aid in the recognition of migraine and to help the optometrist make a differential diagnosis of the migraine cases from the other causes of headaches. The etiology, diagnosis and treatment will be given, with special considerations in the optometric management of these patients.

Course 52
Tachistoscopic Training Procedures
Howard N. Walton, O.D.
Los Angeles, California
A two-hour course—$4.00
Periods: F-2, F-3

The relation of tachistoscopic training to the speed of reading has been under study for a number of years. As a result, a number of specific procedures have evolved. These will be reviewed and evaluated. This course will be of special interest to all optometrists engaged in any form of visual training.

IN APPRECIATION

This third annual series of Academy Post-Graduate Courses will be a most outtanding one . . . and it will be made so by its distinguished corps of Instructors.

At this time the Academy wishes to express, to the many selected individual optometric practitioners and others who are serving as instructors; as well as to those faculty personnel from Illinois College of Optometry, Indiana University, Los Angeles College of Optometry, the Ohio State University, Pennsylvania State College of Optometry, University of California, University of Chicago and the University of Michigan who serve as instructors; and to the research personnel of the American Optical Company, Armorlite Company, Bausch & Lomb Optical Company, General Electric Company and the Titmus Optical Company who serve as instructors; our deep appreciation for their splendid cooperation in making this program of Post-Graduate Optometric Education possible.

THE COMMITTEE

FOR ADVANCE REGISTRATION: For the convenience of readers an Application Form will be found on page 522.

CONDENSED SCHEDULE OF COURSES

Course	Instructor	Subject	Hours	Periods
1	Allen	Subjective Testing Procedures	2	F-2, F-3
2	Allen	Efficiency in the Optometric Examination	2	F-E
3	Schanfield	Accounting and Taxation Practice for Optometrists	3	W-8, T-8, F-8
4	Alpern	Phorias—Physiological Considerations and Practical Applications	2	T-4, T-5
5	Alpern	Recent Advances in Visual Science	2	F-10, F-11
6	Bailey	Refraction of the Pre-School Child	2	F-10, F-11
7	Bailey	Sun-Glasses	1	F-4
8	Bannon	Space Eikonometer Technique of Measuring Aniseikonia	1	W-4
9	Bannon	Clinical Judgment in Prescribing Aniseikonic Corrections	1	W-1
10	Bannon	Management of Difficult Refractive Problems	1	T-1
11	Bannon	Practical Aspects of Multifocal Corrections	1	F-1
12	Bing	Evaluation of School Testing Procedure	2	F-2, F-3
13	Connolly & Hathaway	Review and Evaluation of Reminder Systems	1	T-4
14	Connolly & Hathaway	Signs and Symptoms of Aniseikonia	1	T-12
15	Copeland	Streak Retinoscopy	4	W-10, W-11, T-10, T-11
16	Dowaliby	Dispensing of Eyewear for Children	1	F-2
17	Dowaliby	Color in the Feminine Wardrobe	2	F-10, F-11
18	Enoch	Case History	2	F-8, F-9
19	Enoch	Ocular Manifestations of Diseases of the Central Nervous System	2	F-4, F-5
20	Feinberg & Sherman	Optometric Applications of Vision Screening in Highway and Safety	4	W-E, T-E
21*	Feinbloom, Filderman & Williams	Visual Rehabilitation of the Partially Blind	3	W-4, T-4, F-4
22*	Feinbloom, Filderman & Williams	Sub-Normal Vision Clinic	3	W-5, T-5, F-5
23	Freeman	The Role of Aniseikonia in Optometric Practice	1	T-8
24	Fry	Evaluation of Quality in Ophthalmic Lenses	1	F-9
25	Fry	Testing Stereoscopies	1	F-12
26	Giglio	Amblyopia	2	F-12, F-1
27*	Graham, Feinbloom, Neill & Policoff	Advanced Course in Contact Lenses	8	W-10, W-11, W-2, W-3, T-10, T-11, T-2, T-3
28	Grupposo	Basic Factors in Space Perception	1	T-9

Course	Instructor	Subject	Hours	Periods
29	Guth	The Effect of Radiation on the Eye	2	F-8, F-9
30	Hirsch & Section	Ocular Pathology Review	6	W-E, T-E, F-E
31	Hirsch	Current Thinking in Myopia	2	W-10, W-11
32	Hecht	Recommended Insurance Practice for Optometrists	2	W-9, T-9
33	Knoll	The Role of Eye Movements in Visual Acuity	2	F-12, F-1
34	Kratz	Vertical Heterophorias	2	W-9, T-9
35	Levy	Psychological Problems in Optometric Practice	3	W-1, T-10, T-11
36	Manas	Vision Training Procedure with the Correct-Eye-Scope	2	W-8, W-9
37	Morgan	Recent Advances in the Diagnosis, Prognosis and Treatment of **Strabismus**	3	W-5, T-5, F-5
38	Morgan	The Turville Infinity Binocular Balance Test	2	W-12, T-12
39	Murroughs	House Calls and Visual Care of the Invalid Patient	1	W-12
40	Murroughs	Unfavorable Prognostic Pointers in the Cure of Strabismus	1	W-4
41	Murroughs	Therapeutic Procedures in Aphakic Patients	1	F-4
42	Murroughs	Orthoptics for Strabismus Patients	3	T-2, T-3, F-3
43*	Neill & Associates	Beginning Contact Lens Practice	8	W-10, W-11, W-2, W-3, T-10, T-11, T-2, T-3
44*	Policoff & Rosenbloom	Subnormal Vision	6	W-E, T-E, F-E
45	Prince	The Early Detection of Ocular Pathology	2	F-10, F-11
46	Prince	The Use of the Slit-Lamp in Diagnosis	2	T-4, T-5
47	Rosenbloom & Robinson	The Optometrist's Relationship to the Reading Problem	4	W-2, W-3, T-2, T-3
48	Schapero	Graphical Analysis	3	T-1, F-12, F-1
49	Shulman	Recent Advances in the Technique of Fitting a Ptosis Crutch	2	W-12, W-1
50	Shulman	Scleral Tonometry and Glaucoma	3	W-5, T-12, T-1
51	Simmerman	Migraine	2	W-8, T-8
52	Walton	Tachistoscopic Training Procedure	2	F-2, F-3

*In each Course the enrollment is generally limited to thirty. In Courses marked with an asterisk (*) the enrollment is limited to a smaller number because of the clinical or instrumental character of the course.

FOR ADVANCE REGISTRATION

AMERICAN ACADEMY OF OPTOMETRY

Post-Graduate Courses

Applications should be made to Dr. D. G. Hummel, 1318 The National City Bank Building, Cleveland 14, Ohio. One-half of the total fee must accompany the application. The balance must be paid at the commencement of the courses. Without exception, everyone enrolled in the courses must register and pick up appropriate tickets for each course. Without them, no one can be admitted. Acceptance of applications will be on a first come first serve basis. When the number allowable in any course is filled, applications will be received on a contingent basis and used in case of cancellation. In case of cancellation the fee will be returned, providing such cancellation is received no later than November 16, 1957.

Advance Order Sheet

Please check the courses you wish to take.

No.of Course	Instructor	Hours	Total Fee	Date	Time

Name_____

Address_____

City_____ State_____

For Use of the Committee on Administration

Deposit_____ Balance_____

Date Received_____

Notified_____ Date_____ Accepted_____ Contingent_____

CUT HERE AND MAIL

"Root, Root, Root for the Home Team"

BVI is playing *your* game! It's battling low standards, cheap material, inferior work.

Every TV spot, film, radio program, newspaper article, booklet or ad pitched by BVI is aimed at building public confidence in you and what you're doing.

Who puts up the dough for all this? Mainly producer and supplier members. They're solid rooters, every one of them. They're keeping your team in the league.

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Better Vision Institute, Inc. 630 Fifth Avenue, New York.

Back Your Backers!

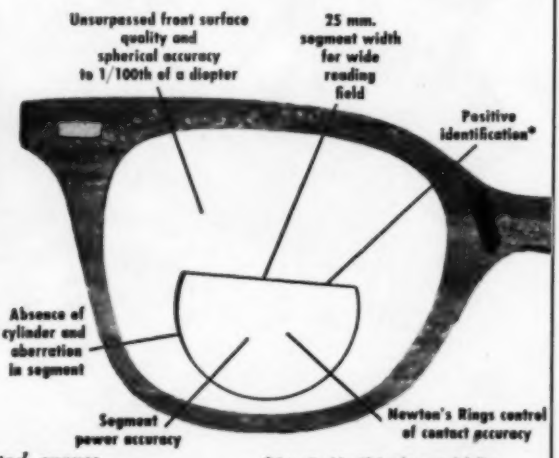
It will pay you while it pays them

May WE offer YOU these patient advantages?

Rx Univis

D-25 Nu-Line T.M.

These special features of the D-25 Nu-Line assure your patients of fine Univis quality in a 25 mm. wide segment bifocal. We can supply from stock.


Unsurpassed front surface quality and spherical accuracy to 1/100th of a diopter
25 mm. segment width for wide reading field
Positive identification*
Absence of cylinder and aberration in segment
Segment power accuracy
Newton's Rings control of contact accuracy

Now . . . as always . . . corrected curves

*Note the identifying brown-pink line T.M.

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THE CORRECTION LENS

This report deals with the eye as an optical system and the lenses which are used in correcting the deficiencies of this system. The author reviews the mathematical discipline on which lens corrections rest and combines this with the ametropias corrected by these means. Written by Dr. Julius Neumueller, Pennsylvania State College of Optometry. Write for Monograph No. 52. 60 pages and cover. 90 cents. Send stamps or coins to

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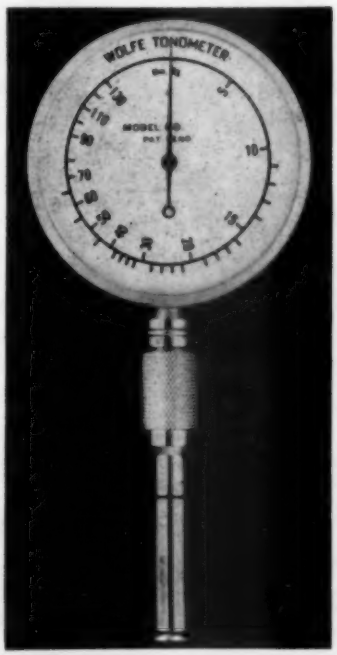

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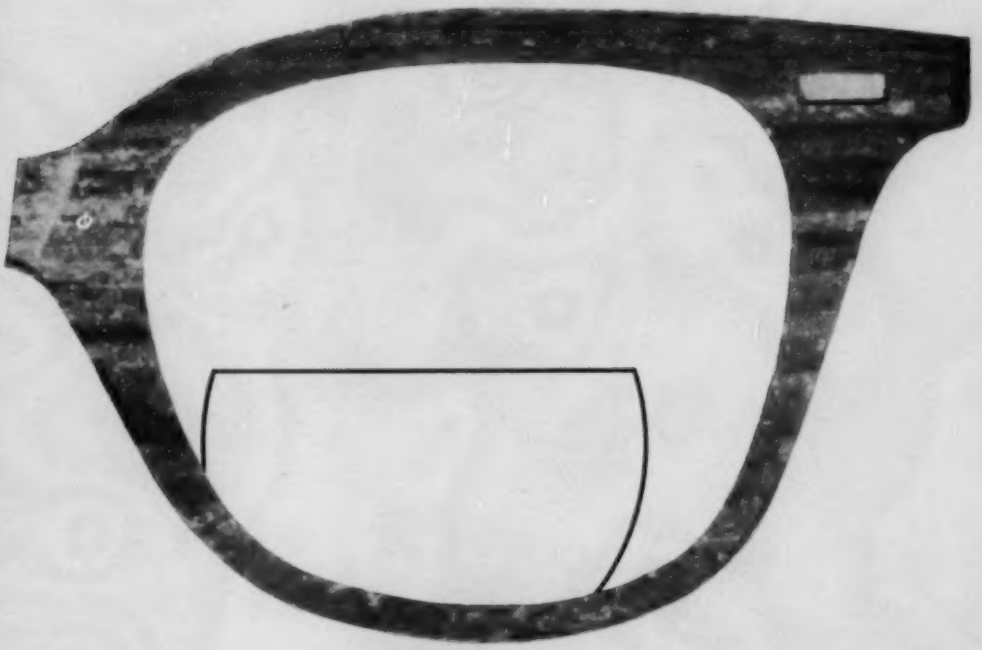

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